# Municipal and County Engineering

**DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS**

Vol. LXII. MAY, 1922 No. 5

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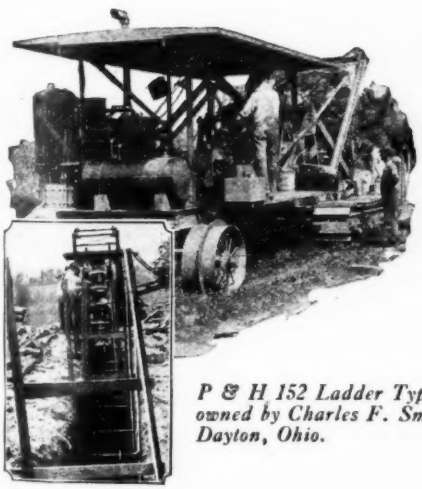

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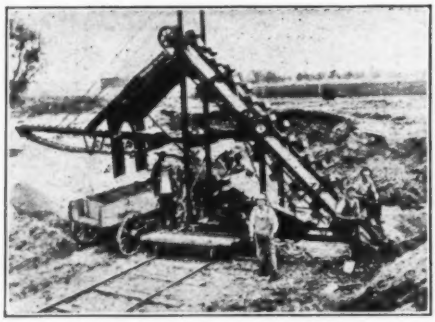

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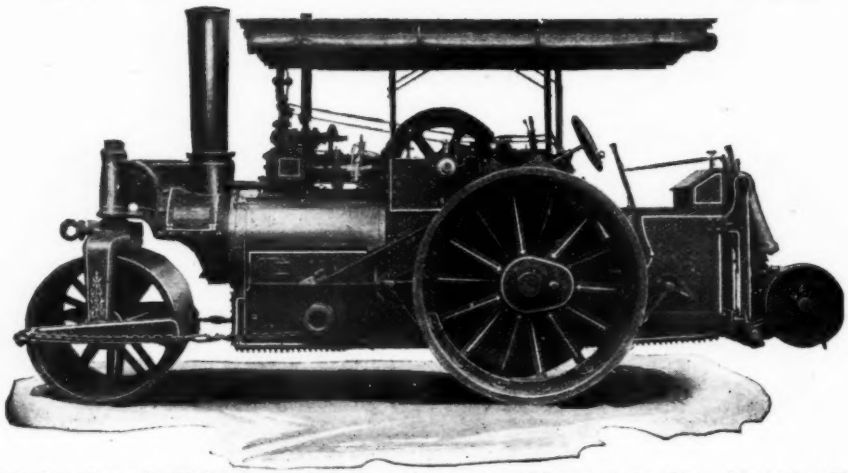

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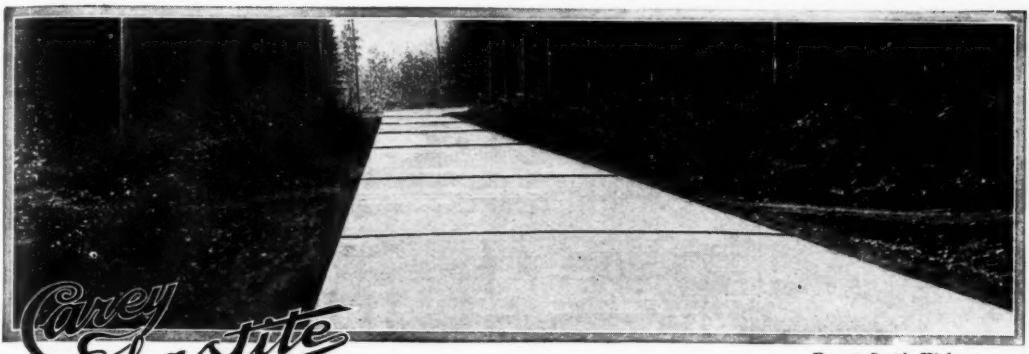

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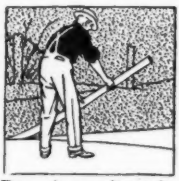
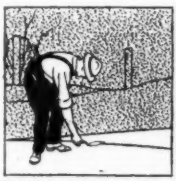


Removing spacing-strips after concrete is poured



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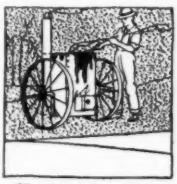

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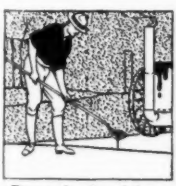

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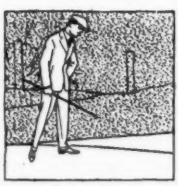

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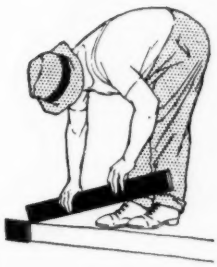

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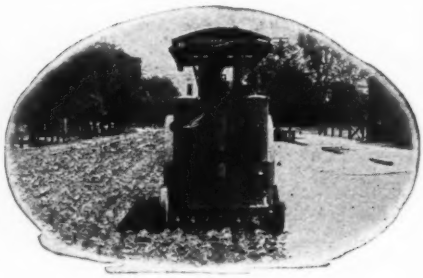

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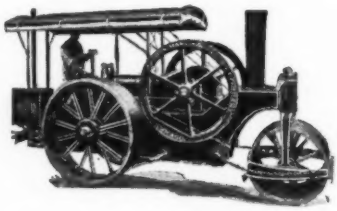

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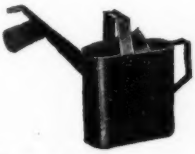

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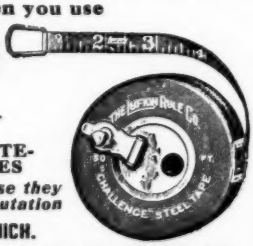


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# Motor Truck Operation and Accounting—81

## MOTORIZATION OF REFUSE COLLECTION SERVICE IN LOS ANGELES, CALIF.

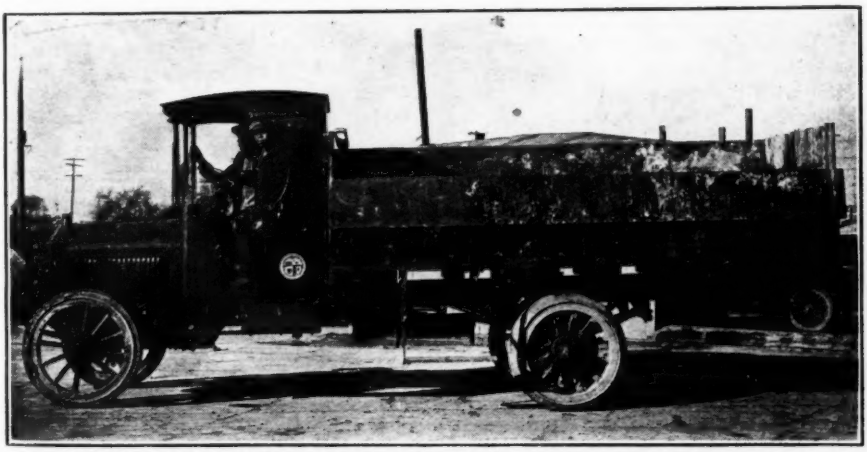
In the installation of 15 motor trucks of 2½ tons capacity for the hauling and removal of rubbish and garbage, City Engineer Griffin, Los Angeles, Calif., has estimated a saving of approximately $25,000 per year over and above the former private contract cost. Previous to the installation of motor equipment by the city, this work involved an expenditure of a sum almost equal to $70,000 per year. The trucks purchased for this work were Model 70-H Garfords, equipped with special bodies, as shown in the accompanying illustration.

The bodies, with a measurement capacity of 10 cu. yds., are arranged with hinged sides, which facilitates easy collection of load. With the sides dropped, approximately two-thirds of a load can be attained. The sides are then conveniently raised, after which the maximum capacity can be reached. Steps are provided on each side of the body for the lifting and dumping of rubbish cans over the highest point with the least possible effort. Quick discharge of the load is obtainable by means of releasing the tail gates hinged at the bottom at the rear of the body.

The Los Angeles authorities designate certain sections of the city in which the trucks will collect rubbish and garbage on given dates. Boxes containing tin cans and noncombustible rubbish are set near the curb by property owners. The trucks are manned with a driver and two helpers, who pick up boxes from the curb, dump the rubbish into the truck as it passes along. In sections of the city where long alleys run between the rear of houses, it is compulsory for the property owners or occupants to place the boxes on a shelf, which eliminates the necessity of helpers stepping down, thus saving time in loading. When the trucks are fully loaded, they are driven to a privately owner foundry, backed up to a dump and there unloaded. Through an incline of the dump, the tin cans and rubbish slide to an endless belt about 40 ft. in length, where broken glass and bottles are segregated, after which the tin and metal is elevated to a bin and pressed into a solid mass about 3 ft. square. These squares are later melted and made into window weights.

The garbage trucks operate in much the same manner as the rubbish collectors. Open sheet iron bodies are provided. When fully loaded they are driven to flat cars with steel sides, bodies with load elevated by means of a crane from chassis over flat car and dumped. This operation is made in not over five minutes' time. The loaded cars are then made up into "The Garbage Special" and taken to a ranch a few miles from the city.

This system of rubbish and garbage removal and disposal is making for better



GARFORD 2½-TON TRUCK WITH SPECIAL MUNICIPAL REFUSE BODY. THE CITY OF LOS ANGELES OPERATES A FLEET OF 15 OF THESE UNITS.

and more satisfactory sanitary conditions in the City of Los Angeles.

## A 30-MILE SPECIAL MOTOR TRUCK HIGHWAY PROPOSED IN CONNECTICUT

(Editor's Note: The following well-rounded statement pertaining to the proposed special 30-mile motor truck highway in Connecticut, published in The Hartford Courant of April 26, 1922, was brought to our attention by Mr. Charles J. Bennett, State Highway Commissioner, Hartford, Conn.)

Owners of motor trucks using the 30-mile state highway which it is proposed to build in Connecticut exclusively for motor trucks, would be required to furnish the $1,500,000 or more to pay for it, under a plan evolved by the state highway department for presentation to the Legislature.

By the assessment of a tax of 2 cts. a ton mile against each freight-carrying truck passing over the highway, the plan contemplates the raising of about $280,000 a year until the cost of the project has been liquidated. Whether the money would be collected in toll charges similar to the manner in which such charges are taken up on Connecticut toll bridges is a detail which is left for development pending the action of the Legislature and a determination of the constitutionality of the plan.

The department's figures are based on an exhaustive survey of truck and passenger traffic over the Boston Post Road at Greenwich and the state highway at Thompsonville, which showed that approximately 14,000,000 ton miles of pay freight each year pass over the highway route between Bridgeport and the New York state line which it is proposed to parallel with the truck highway.

*$12,210,000 Transportation Value.*

Freight, the transportation cost to the consumer of which is estimated at $2,210,000 a year, at prevailing railroad rates, is using that section of the Boston Post road today, according to figures drawn from the highway department survey. Figuring the value of the passenger service rendered by a million passenger cars using the section annually, at the railroad rate of 3.6 cts. a mile, the passenger service on that road for a year is estimated at $10,000,000. Taken together with the value of freight transportation, this makes a total of $12,210,000 in transportation value.

It is figured at the rate of 3.3 passengers for each automobile riding an average of 50 miles and an average truck haul of 47.4 miles. The value of freight transportation to the consumer is put between 12 to 18 cts. a ton mile.

*Most Regular Trucking Companies*

It was shown by the survey that 55.6 per cent. of the trucks passing through Greenwich are regularly engaged in hauling freight over that state road. About 16 per cent. are 2-ton trucks, 12.7 per cent. 5-ton trucks and 4.2 per cent. trucks over 5-ton capacity, which was taken to indicate that the heavy trucks, over 5 tons, do not constitute a serious factor in Connecticut traffic at this time. Every third truck was found to be overloaded, and the overloading was not by any means confined to loads of heavy material such as sand, gravel and brick. It is restricted to no typical group of commodities, but is almost universal. Of the number of loads exceeding the state limit of 25,000 lbs., 87.8 per cent. were overloads per capacity; 88.7 per cent. were by regular trucking companies. Thirty-nine out of 41 trucks were loaded from 846 to 1,560 lbs. an inch of tire width on the rear axle, the maximum allowed by statute being 800 lbs.

*3,250,000 Passengers Carried*

The highway department survey was made during two weeks last October in co-operation with the Bureau of Public Roads of the United States Department of Agriculture, but such a mass of information was collected that it was not until this week that the statistics of the survey were completed. The daily average of passenger cars passing the checking station at Greenwich proved to be 3,800 and, as it was shown that each car carried an average of 3.3 passengers, the conclusion is that over 3,250,000 passengers a year are carried over the road.

Over 53 per cent. of the passenger cars observed carried Connecticut license markers, 37.4 per cent. had New York markers, 3.2 per cent. Massachusetts and the same percentage New Jersey. The daily truck average was 792. The number of motorcycles and horse-drawn vehicles on the highway was so small in comparison with passenger cars and truck traffic that their numbers were not reported.

*Recommends Separate Roads*

It was pointed out at the highway department that the daily average of motor trucks on the Boston Post road is too great for the safety and comfort of people in passenger cars and that the num-

ber of the latter was so great as to handicap the rapid movement of commerce in the hundreds of trucks. These recommendations, based on an analysis of truck overloading, were made as a result of the census.

1. Classification of highways.
2. Seasonal restriction of loads.
3. Prohibition of overloads per capacity and restriction of tire to 800 lbs. an inch width of wheel.

Development of the first recommendation led to the proposal recently announced in "The Courant" for the construction of the 30-mile state highway for motor trucks only, extending from Bridgeport to the state line at Greenwich.

*Might Take Twenty Years*

It was said at the highway department that the constitutionality of taxing motor vehicles for the use of such a road was a matter that would have to be determined by competent authority and that the department was merely interested in suggesting a possible way for financing the project, which incidentally would be unique in road building in the United States. If the ultimate cost of the road should reach $2,500,000, for instance, it was felt that the cost, plus interest in the event of a loan, could be covered by the 2-cts.-a-ton-mile charge in about 20 years at the present rate of traffic. It was assumed, however, that the amount of freight transportation over the road would increase each year.

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## ORGANIZATION AND OPERATION OF MOTOR EQUIPMENT.

*By J. F. Winchester, Superintendent of Motor Vehicles, Standard Oil Co. of New Jersey, Newark, N. J.*

Fundamentally, the operation of motor vehicles for profit or business purposes is like any other business—it must be organized. To make a success of a business of this type, the party venturing into it should study the various angles of the particular line he intends to pursue, and then carefully outline his course of action, with the full realization in mind that there is no line of business that presents as many possibilities for "leaks" as an unorganized motor bus or truck business.

Those who have watched the coming and going of various bus and trucking concerns in the last few years have no doubt realized that something was wrong.

MUSHROOM TRAFFIC LIGHT
AN ACCIDENT PROOF CAST STEEL
BRILLIANTLY LIGHTED
TRAFFIC MARKER
A unit that is indestructible, and even more conspicuous at night than in the day time.
It has low maintenance expense, no replacements, and is supplied with a Duplex lighting system, insuring constant service.
This unit is in use in over one hundred cities at the present time, giving perfect satisfaction.
The only cast steel unit on the market.
Bulletin on Request
Electrical & Specialty Supply Co.
MADISON TERMINAL BUILDING
Chicago, Illinois

# Vocational Truck Selection

It is the opinion of many in the truck industry that truck buyers will pay increasing attention to the service rendered by trucks in any specific field in buying trucks to use in that field. Of course this is a natural method of selection but many buyers in the past have not paid particular attention to the performance of truck types in their field before placing their truck orders.

It is held by many that within the next very few years the great majority of all trucks sold will be sold on the **Vocational Plan,** because the public will insist on being shown just what trucks have done and will do in actual operation in the line of business in which the buyer is engaged and not in some outside line.

It is now possible for prospective buyers of trucks to secure detailed and accurate information regarding truck performance in every field.

We can assist you, without charge, in selecting trucks that have made good in the municipal and county construction field if you so request.

**Municipal and County Engineering**

**702 Wulsin Bldg.** **Indianapolis, Ind.**

My observations have led me to believe that the missing link was a lack of true appreciation of the various factors entering into an operation of this kind. These factors were lost sight of by the various interests, one of whom is the small operator, who, because of the lure of easy payments and large profits held out by various sales organizations, went into business and lasted for the time being, or while there was an abnormal demand for transportation facilities, and also by some of the larger companies, such as public utilities who have failed to realize, and do today, that through proper organization of the various factors entering into motor transportation, they are able to operate a fleet cheaper than the individual operator of one or two outfits, and through co-ordination of this type of service with the present-day facilities, such as water, steam, established express companies, or trolley service, that they are able to render to the public a modern type of service for which the public is willing to pay, in many instances, a premium, because it facilitates the transportation problem and results in a material saving of time being effected, and, in the majority of instances, within a limited radius. Transportation of this kind, through organization, can be put on a profitable and stable basis.

Consider an illustration of a haphazard installation, of which there have been many in the motor trucking industry. A business concern decides to become up-to-date; they will motorize, they study catalogues, call in salesmen, and finally decide on a certain type of vehicle because they are impressed with the looks of it or its sturdy construction, or were impressed with the promise of service that had been made by the salesman.

The machine is received, the old employe is laid off—lack of time and expense preclude the teaching of the horse-drawn vehicle driver how to operate the new outfit—and the new vehicle is placed in the hands of an experienced chauffeur. It does the work fine for a few weeks, then lack of inspection results in its having trouble, delays result, indifferent repairs are made, continual expense is entailed, and in a short time this concern feels that they have joined the class of "all going out and nothing coming in."

If this same concern was considering putting in an electric motor, a steam boiler, or some similar piece of equipment, invariably a consulting engineer or a man trained in other than sales lines, analyzes the problem and receives a fee for his services. After the machine is installed it is placed under the supervision of a competent or licensed engineer, the grade of license depending on the equipment to be handled or the skill required, and, while it may be stated that all professional chauffeurs require a license before being permitted to drive on the public highway, this license in no way indicates his skill from a mechanical standpoint, and, in many cases, because of the laxity in drivers' examinations and the possibilities of getting by through influence, a license to operate is but little indication that the party so licensed is a competent operator.

Again, compare a 5-ton installation that costs from $5,000 to $6,000, or even $7,000, and then requires an annual expenditure in some lines of work of a like amount for operation, with that new highway engineer whom you are thinking of engaging next season at a moderate salary.

You will size up his age, health, experience, personality, recommendations, and when he starts in you will advise him carefully how he should fit himself into the organization. Your bookkeeper will check his expenses and salary against certain contracts; you will measure his efficiency, and are ready to do so because you consider it good business. Have you considered the contrast between the way you and others check your investment in this human equipment, who has every incentive for efficiency, as against the inanimate piece of machinery which can only produce profits if properly supervised?

I only picture these past occurences and analyses to draw attention to the realization that organization is necessary, and further to draw attention to these let us consider the factors that enter into motor transportation enterprises, none of which can be neglected to any great degree if the outfits are to be economically operated and maintained. I know of no better presentation of them than the outline recently presented in a paper before the S. A. E. by Mr. M. C. Horine.

The factors presented by Mr. Horine cover a wide range of consideration and nesessitate a general knowledge of:

Highway engineering
Mechanical engineering
Automobile engineering
Electrical engineering
Transportation
Bookkeeping
State laws, etc.

However, Mr. Horine neglected to include the human in his table of economic factors, which I consider has an important

bearing on the efficiency of any operation. So much general knowledge is known about an automobile by the general public, yet, there are so few specialists who understand the fundamentals of the various factors that careful selection and training is necessary if the organization is to be efficient.

The organizer of a department of any size should have a knowledge of manpower, and understand the phychological elements of organization in order that harmony and team-work may prevail, without which discipline and the possibility of economical operation would be at a premium.

These specialists all co-ordinate the activities of the motor vehicle in an economical way with the rest of the business. The type and extent of the organization which one would adopt depends to a large degree on the number of vehicles to be operated and the extent of the territory which they cover.

Each type of industry, whether it be a contracting concern, silk, express or oil business, has surrounding it certain business conditions with which the supervisor of motor vehicles must be more or less familiar.

For instance, in road building it is not only necessary that a man have a general knowledge of the motor vehicle itself, but it is also necessary, if he is called upon to make an installation of any vehicle for road oil or binder distribution, that he have a general knowledge of the material to be applied by the vehicle and the various types of pumps that might be used for its application. His other general engineering knowledge would fit him to work up a design that would be suitable from a mechanical standpoint. The conditions surrounding an installation of this kind would be mounting, driving and gearing the pump so that it would be practical to operate, accessible, economical to maintain, and capable of giving the proper volume distribution for the various types of work encountered by the vehicle.

I do not presume to outline the type of organization that might fit your varying conditions. We have an organization chart which provides for the handling of approximately 1,200 to 1,300 vehicles which are operated over a widely scattered territory in the States of New Jersey, Maryland, District of Columbia, Virginia, West Virginia, North and South Carolina, and which are under centralized control.

This organization chart is the result of ten or twelve years direct experience in motor transportation, and the vehicles under this plan are being operated in direct competition with other types of transportation, namely: horse-drawn and steam. In at least 98 per cent. of the cases each outfit is doing the work, at least within a slight margin, more economically than it could be done by any other form of hauling.

Our chart indicates that the branch of the company in which these vehicles are being operated is a sales organization, and the relation of the motor vehicle department to the balance of the organization. The chart also indicates that the Superintendent of vehicles has directly under his supervision men who handle the inspection and mechanical upkeep of the outfits, and that he is responsible for the installation of the various types of motor vehicles, and, while not directly responsible himself for the vehicle operators, he is in direct touch with them through education and the auto inspectors who visit periodically all of the outfits.

The output from the vehicles is directly up to the Branch Sales Manager through the Route Foreman, and the gathering together of the reports turned in by the two departments is under the supervision of the Accounting Department.

The painting of the vehicles is done by the Construction Department, in most cases, for economic reasons. In forming a shop organization, one has to take into consideration the fact that in automobile work practically all branches of the mechanical arts are encountered. A man who superintends this work should be one who has fundamentally been educated to think along mechanical lines. I prefer one who has served an apprenticeship as a machinist or tool-maker, and has educated himself along engineering lines. He may be called upon to consider problems wherein the following lines of work may have to be considered:

Designing
Pattern making
Foundry practice
Machine shop practice
Tool-making practice
Blacksmith practice
Electrical
Painting
Tinsmith
Wheelwright
Body building
Carpenter
Upholstering
Stockkeeping
Service problems, etc.

A man so equipped will be in a position

which will tend to make him resourceful and capable of instituting many short-cut methods, which will result in a large yearly saving. He should, along with his mechanical training, possess those qualities which fit him to instill in others a desire to perform their duties in a harmonious, careful and conscientious manner.

When a vehicle is to be purchased, the type of work and the country into which it is to be installed are carefully studied from the various angles pertaining to an efficient installation.

In my particular line, a canvass is made of the approximate number of gallons or packages that will be delivered in the respective territory under consideration. We study, particularly, the adaptability of the road to carry it so that we may have installed the proper transmission and rear axile ratios, tire make and sizes and take particular pains to install an outfit whose gross weight is suited for the road and bridge conditions into which it is going.

Care should be taken in studying an individual installation to make sure that it will compare from an economical standpoint with other types of transportation that are at one's command.

The matter is becoming a more complicated one yearly regarding an installation. Legal restrictions, high license fees, and general taxation necessitate a closer studying of this problem than ever before.

The question of standardization has to be studied, and while standardization can be argued for from a standpoint of making it much easier to handle the vehicles, yet, on the other hand, when a large fleet is considered, it is well not to limit the vehicles to any particular make, for the reason that you have left no direct method of comparison as between one make and another. We standardize the make in a district or a station, and try to hold a station to not more than two makes, which simplifies the service and operating problem.

After having taken into consideration the various possibilities, and it has been found feasible to make installation if goods are to be economically hauled, the largest load possible under existing conditions should be hauled, for the reason that all operating figures will show that the unit cost, such as ton-mile, etc., is materially higher where small units are used. Also, from the standpoint of general operating economy, the installation of a heavy unit is preferable to a small one, as a large unit simplifies the problem of control and handling for the reason that fewer units are required.

That the location of a machine may be determined at any time, accurate records are kept of the vehicle number and the station to which it is assigned in booklet form, and as outfits are moved from one station to another they are taken care of by "Between Station Transfer Reports."

For the ready reference of those who are directly concerned in the location of vehicles, a control board is run and all vehicles in the territory are spotted in their respective locations by numbers on this board. The make of vehicle is indicated by the shape of the cardboard on which the number is printed, which cardboard takes the form of the vehicle radiator. The type of service, such as gasoline or oil tanks, barrel or package truck, is indicated by the color of the tack head. By this control board, vehicles may be located at any time, whether they are in the shop or at the station to which they are assigned.

The shop section of the control board makes provision for showing whether the truck is in for a complete overhaul, is waiting for repairs, whether it is in our own or an outside paint shop, and the number of trucks that will be ready for service in half a day's time. Accurate record is kept of all truck movements and the time out of service for any reason.

In the operation careful study has to be made of the various factors noted. Particular care must be exercised in the selection of a driver if the operations surrounding the various factors laid down are to be successful in the selection of an operator.

In the early days, it could safely be stated that the success of a machine was largely dependent upon the operator. That is not true today, however. Some outfits will stand more abuse than others, yet it is well to select an operator who is so constituted that he has the interest of the business at heart.

An operator should have personal obligations which will tend to instill a sense of responsibility and make him careful of the equipment he operates. In my opinion, a man of 33 years of age or upward, who has a family or some other obligation, if carefully broken in from a mechanical standpoint and instructed along pertinent lines, will assist in many of the operations that make for economical deliveries.

While a general study of the various factors that enter into delivery is the duty

of the supervisor or route man, yet it is a fact that through education and co-operation, an intelligent operator will promote economical operation from many angles, particularly when he comes in contact with the public.

In an operation such as road construction, where a certain amount of skill is required in the laying of material such as asphalt or other road material, a careful, conscientious operator will, with some instruction, take on, as a matter of pride, the study of various conditions which will impress the supervising officials and relieve you of many minor duties. An operator of this kind takes pride in his work, cuts down the amount of supervision necessary, and results in greater output, accurate reports, etc.

Provision is made for the operator to have a given time each week to go over chassis, lubrication and other parts that may need attention. The operator has outlined to him the parts of the mechanism he is responsible for, which are indicated by an asterisk (*) being placed beside these items on the inspection report. When the operator encounters trouble he cannot solve he turns in one of these reports.

No vehicle should be installed and left in the hands of the operator without some provision being made for it to receive a periodical mechanical inspection. Inspection is the means of taking care of minor adjustments that are made necessary by the constant vibration and natural wear which any machine is subjected to. It provides a means for taking the "stitch in time that saves nine," and eliminates the possibilities of minor adjustments rapidly becoming worse and eventually resulting in major repairs.

The type of inspection system to employ depends to a large degree on the fleet under consideration. Our inspection force of a body of men who are first-class repair men who have the faculty and personality to instruct and assist the operators or marketing men with whom they come in contact. They are held responsible for the mechanical operation of the truck from its installation as a new unit, or after its overhaul until it is ready to be returned to the shop.

They maintain constant schedules and visit a truck periodically. One inspector will take care of from 15 to 24 vehicles, depending on the type, the amount of territory they have to cover, for it is obvious that a man can take care of a much larger number of vehicles operating from a central garage than one who has to visit a number of plants or stations.

Besides being responsible for the mechanical condition of the truck, our inspector has to examine for proficiency all men who are employed as operators. He is held responsible for any neglect which may result in our having a vehicle go on the road which presents other than a first-class appearance, and reports any irregularities and indifference exhibited toward the rules that are laid down for the motor vehicle operators' guidance.

Provisions are made to overhaul the vehicles when needed in a central repair shop. Outfits are brought in for repairs during off seasons, or are replaced by "reserve" equipment, which is held for this particular purpose. Every effort is made to plan the movement into the shop so that the outfit will receive prompt attention. The progress of the work is checked by a weekly Shop Report which materially assists in checking up the shop activities and provides an index of work accomplished.

To obtain the most economical results, it is best to adopt the unit repair basis. This provides for the carrying of a number of complete units which can be readily substituted for the worn parts, and the worn parts can be undergoing repairs after the chasis is in the paint shop or on the road.

The shops are divided into departments, such as chassis, motor, gear box, rear axles, electrical and overhaul, and a competent specialist is engaged for these respective duties. As a department grows, the old employe should be worked into a position of working foreman. This training should fit him to assume greater responsibilities. I find that more accurate and economical results are obtained under this method than by permitting a man to do all-round work, and, besides, through this system it is possible to detect the source of poor workmanship or failures.

Inspection is provided in each department through the activities of the foreman and final inspection of the complete job is provided for by a man who is entirely responsible to the Superintendent alone for the passing out of work.

Necessarily in an organization of this kind emergency service has to be provided. This is done by carrying a stock of parts at the main repair shop, and in small quantities at strategically located points. At the main station this stockroom provides for the shop needs, which facilitates repairs. In any organization

where constant service by the vehicle is an asset, an efficient stock or service depot is a wonderful thing. It provides a means for filling wants in any emergency which places the vehicle in a position to operate at all time.

To provide proper service it is necessary that correct mechanical information be kept on file, and changes in the mechanical condition of a vehicle kept up to date. We provide for this by the vehicle manufacturer, which is filed with a standard mechanical information sheet. If these records are properly maintained the service man has a ready reference for each vehicle, whih will remove a great possibility of incorrect parts being supplied.

A well kept truck should be kept painted periodically. Paint protects the wood and metal surfaces from the elements, and provides a means for increasing the value of the vehicle by making it a traveling advertisement. As I travel I am often surprised to note that some concerns pay many dollars for select sign locations along highways, etc., and then neglect their motor equipment. If advertising pays, I can concieve of no better medium than a well-kept vehicle which daily encounters many more people than the average signboard.

A Paint Shop should be well ventilated, have dust proof varnish rooms, and have facilities for rapid drying, although some wonderful results are accomplished along these lines by small shops with limited facilities.

That the officials may know just what each vehicle is doing, and be provided with a basis of comparison with other mediums of transportation, accounting is necessary. Any system should be as simple as possible, yet provide a clear and distinct method of comparison. We do this by summarizing our entire figures on a suitable sheet. This form analyzes where the money is spent on the vehicle, and the results are shown in groups, by makes, capacity, style of service, and year of installation. It is a progressive record from which can be determined a group performance after a number of years' service as compared with its first year. This is a semi-annual report.

Care is taken through a carefully prepared primer, to see that proper distribution of charges are made.

To complete this report necessitates a group of auxiliary forms, some of which show in minute detail the efficiency of the Department, or work being performed. These include:

Delivery,
Mileage Run,
Gasoline Consumption,
Stock-keeping Records,
Analysis of Distribution in the Central Shop,
Analysis of Inspectors' Time and Expenses,
Tire Records,

and others from which we can minutely dissect the vehicle's efficiency from any angle that might be required.

We do no unnecessary work; for instance, no mention is made on our form of Cost per ton mile, but if for any reason this is desired, we can work out a particular example from the information at hand.

Accurate records are kept of the various types of tires used. Tires are bought on an adjustment, or on a guaranteed price per mile basis. In order that the tires may be properly adjusted and that we may be in a position to compare the relative merits of one make with another, it is necessary that these records be maintained.

Provision is made for taking care of the various types of tire equipment. In the case of solid or cushion tire equipment, a report is made when a tire is applied and its record is kept in the office on the solid tire record. In the case of solid or cushion tires, when once applied to a wheel, they remain there until finally worn out, with but few exceptions. These records are easy to keep as compared with those necessary for pneumatic tires.

Pneumatic tires, which are apt to come to grief through puncture, etc., require more detailed care on the part of the operator, and to assist him in keeping proper records we supply a definite set of forms. These forms facilitate the operator keeping an accurate record, and when a tire is sent in to a central stock room to be adjusted, it is taken care of through a special form of tag, which is used as a shipping and mailing tag. This tag is so arranged that it can be torn in sections when about to be used, and one of the stubs, bearing the same serial number as that part which has been sent through the mail and on the tire, is retained by the operator. Through this tag we are able to check shipments and mileage very accurately.

While it may seem to some that the expense involved is not justified, my experience clearly shows that accurate re-

cords of this description should be kept. It is surprising to note the large saving that can be effected with some types of tires as compared with others, both from a standpoint of Tire Cost per Mile, and Mechanical or Repair Cost per Mile.

A summary of the mileage obtained from all tires is made up semi-monthly and turned in to headquarters. These records give us a comparison between the different types and makes of tires.

Provision is made through these detailed reports, for the various executives of the organization to keep in intimate touch, through analytical forms.

Accounting forms may be obtained economically from various sources, and in the majority of instances under standard methods laid down it will be found that approximately two-thirds of the charges are socalled "Fixed Charges," and one-third "Variable Charges."

I call this to your attention, because if economy is obtained, the Moving Load and Active Factors are the ones which should receive close attention. Because a vehicle is a mechanical device these are often overlooked, and great stress is laid upon the maintenance and up-keep factors. These latter factors in modern machines will remain practically constant, provided speeding and overloading are eliminated.

The problem of material transfers and interurban delivery by motor truck, and the feasibility of employing motor buses is becoming more generally recognized by some of the larger companies. This is indicated by the desire of some of the larger old line railroads and transportation companies having in mind the adoption of unit carriers, which can readily be transferred to motor vehicles. One such installation, I understand, is being made by the Erie R. R. for the transfer of material between its Jersey City yards and New York City, and I believe other railroads have similar installations in mind. Traction companies are realizing that the buses can be adopted with profit, to act as feeders for its main trolley lines. These installations are being made only after careful study of all angles pertaining to the problem, and there is no doubt but what the future will bring forth a considerable growth along these lines. The possibilities of this type of transportation call for greater co-operation among all affected, and the industry as a whole should not be judged by past performances of many irresponsible operators, who, because of selfish interests, have not taken into consideration the rights of the public at large, which resulted in abuses springing up that have caused a general feeling of hostility towards this type of transportation. There is need for a greater co-operation if the operating problem is to be satisfactorily solved. Excessive taxation and restrictive laws which seem to be springing into existence over the country, will only result in the throttling of an industry, which is yet in its infancy.

The foregoing matter is from a paper by Mr. Winchester presented at the recent annual meeting of the New Jersey State Highway association.

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## MOTOR TRUCK NEWS NOTES

*Danger of Red Tail Lights*

The use of red for tail lights on automobiles is deprecated in an article in The Railway Age. This color, it is argued, should be restricted for use at extra dangerous locations, such as railway crossings, boulevard crossings and at places where material is piled in the streets. When an automobile driver follows red lights for mile after mile, it is said, the monotony nullifies their effect as a danger signal.

An accident occurred in which the chauffeur said he had been following the red lights of cars ahead, and when he approached a railway crossing he took it for granted that the lights on the gates were those of an automobile. He turned out to pass the supposed car, ran through the gates and was struck by a train. The remedy suggested by The Railway Age is the use of yellow tail lights for automobiles.

*Detroit Fire Department Fully Motorized*

Fifteen years ago all of Detroit's fire apparatus was horse drawn. On April 10th the last horse-drawn vehicles were discarded, the horses sold and now Detroit's Fire Department is completely motorized. There are those who sentimentally say, "Too bad to shelve such intelligent animals," but efficiency and prodence answer that motor equipment is the only modern way to fight fires. Time element is everything, and the 10 extra minutes on the way to the fire may mean untold loss.

*Novel Method of Removing Snow From Paved Streets in Salt Lake City*

During the past winter immediately after the bulk of the snow had been removed from the paved streets in the busi-

ness district, by means of snow plows attached to motor trucks, a very novel but thorough method of freeing the pavement from snow was put into operation. Five flusher tanks each with a capacity of about 1,000 to 1,200 gals. were used.

Commissioner of Streets Burton had noticed each winter that the overflow of warm water from the City's Hot Springs, located about 1¼ miles north of the business center, entirely cleared the pavement of snow and ice. He conceived the idea that it would be entirely feasible to load the hot water into tanks and with the short haul use it to advantage in clearing the snow and ice from the pavements in the business district.

This idea was put into practice with splendid results. Within 24 hours after the heaviest snow storm experienced during the past winter, when the temperature was around the zero mark, the main thoroughfares were completely and thoroughly cleared of snow by the use of the snow plows and the hot water flushers. The water has a temperature of about 110 degs. when it leaves the flushing tanks under a high pressure. With five tanks in operation almost a continuous stream of hot water is kept playing on the snow until the streets are clear.

The entire cost of this work for December, 1921, and January and February, 1922, an unusually hard winter, was a little under $6,000 per month. The old method of hauling the snow from the street intersections only was nearly as expensive as this complete operation.

*Cost of Road Dragging by Truck in South Dakota*

Douglas County, South Dakota, dragged 1,507 miles of road with an FWD 3-ton truck and a large drag during the summer months of 1921. The following figures show the comparative costs of doing the job with a truck and hiring it done with a tractor.

WORK DONE

| | |
|---|---|
| Miles per gallon gas.. | 1.9 |
| Miles per gallon oil.. | 35.8 |
| Miles dragged ..... | 1507 |
| Gallons of gas used... | 787 |
| Gallons of oil used... | 42 |

This work was all done in low gear, hence the low mileages.

COST PER MILE

| | |
|---|---|
| Gasoline ..... | $ .12 |
| Oil ..... | .02 |
| Driver ..... | .185 |
| Repairs ..... | .032 |
| | $ .357 |
| Cost per mile with hired tractors. | 1.25 |
| Saving per mile using trucks..... | $ .893 |

The total saving on this job was $1,345.75.

## STATE BRICK PAVEMENT SECTION ON NATIONAL HIGHWAY IN INDIANA.

Contract for the construction of the first brick road in Indiana to be built under the direction of the State Highway Department has just been let at a cost of $219,916.78. Indiana was one of the last states in the union to establish a highway department, and while many miles of brick roads have been constructed in the past by the various counties, the contract just let is the first action of this kind by the state.

The section to be paved with brick is 6.897 miles long and extends from Putnamville to a point 1½ miles east of Mt. Meridian. It is a part of the old National Road which runs entirely across the state, extending from Cumberland, Maryland to Jefferson City, Missouri, and is the principal traffic route between Indianapolis and Terre Haute.

When the National government planked the road west of Indianapolis with white oak in the neighborhood of 75 years ago, vitrified paving brick as they are now known and manufactured, did not exist in this country. Had they existed Indiana motorists today might be rolling along over brick roads nearly a century old as they are in Holland, where such roads, still in service, were build by Napoleon.

Decision of the state highway department to use vitrified brick on this road is in accordance with the recent announcement by Governor W. T. McCray to the effect that brick roads would be included in this year's program.

The bid for brick is $111,916.78 more than the low bid for concrete on this section. The design calls for a 5 in. concrete base, 3 in. vertical fiber brick and asphalt filler. The work will be done by the Carpenter Construction Company, of Terre Haute, Ind.

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## A CORRECTION

Mr. John L. Hershey, author of the article entitled "Making Irrigation Bonds Saleable," which was published on pages 135-137 of the April issue of this magazine, has called attention to a numerical error in the article as published. In the paragraph relative to possible extension of the boundaries of the district on which bonds could not be sold (see page 137) the acreage should have been 2,000 to 3,000 instead of 3,000 to 4,000.

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Builds highest type asphalt roads and streets at a reasonable cost.

A perfect sheet asphalt mixed by nature.

Laid cold on any good base.

No binder course or curb required.

No heating or mixing plant or skilled asphalt workers necessary.

Laid in one course and opened to traffic immediately after rolling.

Not susceptible to damage from the weather.

Adopted by ten states in standard specifications.

In use on Lincoln, Dixie, Jackson Highways and National Road.

Shipped in open top cars like sand, gravel, or stone.

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*Ask for Booklet E.*

**Kentucky Rock Asphalt Co.**

**711-718 Marion E. Taylor Bldg. Louisville, Ky.**

# EDITORIAL

## ENGINEERING LEADERSHIP

Not many years ago the engineer, with some exceptions, was such a thoroughgoing servant that he seldom even sought the form of leadership for which he has always been well equipped. He waited, in a figurative sense, for someone to touch him on the shoulder and say: "I can use you." He shunned direct contact with the public, saying, with a gesture of disparagement and a catch in his voice, that he was "not a politician." But the day came when he began to tire of his self-imposed minor role. He then became vocal in his discontent, but for a considerable period of years did not go beyond his profession for an audience. Discovering, at length, that commiseration has its limitations and that it profited him little to "trouble deaf heaven with his bootless cries," he decided to get into the game and become a leader; to become a master while remaining, in the best sense, a servant.

A very pleasant contrast with the attitude of former generations of engineers, toward engineering questions before the public, was recently presented in Kansas City, Missouri. After the failure, in 1921, of the eleven-million-dollar water bond project for Kansas City, The Engineers' Club of that city, conceived the plan of conducting an educational campaign in a further effort to carry the bond issue, which was urgently needed to pay for new filtration works, two pumping stations, larger feeder mains, reservoirs and other work. The club presented engineering facts and figures to the 170 civic organizations to help the public vote intelligently on the project. A special committee of eleven engineers conducted the educational work and by using modern publicity methods sold this great engineering project to the public. A detailed account of the methods they used is published in the present issue of this magazine.

This is a very good example of engineering leadership. Opportunities for public service of this sort arise from time to time in every community. These facts lead to a wholesome and regenerating conclusion which the individual engineer can be depended upon to reach without the aid of a diagram.

## EFFECT OF CORE DRILLING ON PAVEMENT PRICES

A comparatively recent development in the pavement construction field is the use of a core drill for determining the exact thickness of pavements as a means of checking up the degree of faithfulness, or success, of the contractor in carrying out the provisions of the specifications. These drills are being used by several of the state highway departments. A brief but illuminating article in this issue tells how the use of one of these drills caused the contractor to waive claim to compensation on a section of new concrete road that was not up to the prescribed thickness. It is very significant to note that not only was the contractor penalized in the manner described, but the engineers and inspectors in immediate charge of this piece of construction were discharged.

The core drill is a useful machine on many classes of work and it doubtless has its legitimate uses in connection with highway construction, especially in testing the finished pavement. But those long familiar with practical construction difficulties, notably the clashes between strict engineers and hard pressed contractors, will perceive in this use of the core drill some rather unhappy possibilities. It may be fine in theory but not so good in practice.

In the past engineers have specified the pavement thickness and engineers and contractors have, as a rule, taken all reasonable precautions to insure the substantial attainment of the specified depth. Of course, since pavement construction is not an exact science, depths have varied both ways from the prescribed figure. The introduction of the core drill as a pavement depth testing device raises a serious question as to whether engineers, in their praiseworthy efforts to secure good construction, have not overreached themselves.

All should agree that the engineer who intends to use the core test before paying for a pavement should make that fact very clear in his specifications. The contractor should be warned in advance of this new hazard in his already very difficult and hazardous calling. The method of making the tests should be made

known to the contractor before he starts to build and he should also be told just what interpretation will be placed on the test data and how these interpretations will affect the payments due him. If in addition to this information he knows the disposition of the engineer he will be sufficiently warned so that he can safeguard his interests in making out his bid and in conducting the construction operation.

If the engineer is inclined to be liberal in his interpretations of specifications, making due allowance for inevitable variations from prescribed standards, the contractor will not be greatly worried by the core test. But if the engineer is of the "strict" type the contractor will sense impending disaster if the finished slab is too thin in places and he naturally will increase his bid prices so as to give himself what might be termed "rejection insurance" and at the same time to compensate him for the excess depth which he, as a practical man, knows will surely result from the effort to have the slab of full specified depth at all points. In general the contractor will be inclined, if he follows his best judgment, to bid higher on a core drill job than on one where this acceptance test is not to be used, no matter how sure he may be of the fairness of the chief engineer. This is due to the fact that the contractor's direct contact with the engineering department is through young men who are not only inclined to be overinsistent on the attainment of perfection, but who are themselves afraid of what the core drill may exhume. If a thin slab means that the engineers and inspectors on the job are to be discharged the contractors are in for a hot summer.

Unless, therefore, it is made plain and clear in advance that the core drill test will be used mercifully and with discretion and common sense, it will surely increase pavement prices. What a state may save on one "gift" pavement it is likely to pay back with very high interest on subsequent contracts. The legitimate uses of the test would seem to be confined to the detection of deliberate dishonesty or crass incompetency.

## A SATISFACTORY SOLUTION OF THE "EXTRA WORK" PROBLEM

In an exceptionally well considered and well written article in this issue, a city engineer describes a system he has devised and successfully employed in handling "extra work" charges on construction contracts. This covers one of the points most often at issue in this field, so the article is of permanent interest and value to every engineer, contractor and public official. The author's very evident desire to deal fairly with the contractor is the fundamental on which his procedure is based, but at the same time full protection of the interests of the public is secured.

It is most encouraging to note the ever-increasing good will between engineers and contractors. This is due to many things, of course. Engineers are becoming more practical and more specific and this enables the contractor to become more ethical and more honest. It has been discovered that the contractor is naturally inclined to be honest and he will be honest unless harried into dishonesty either by the vagaries or exactions of the engineer or the desire of some public officials to make political capital out of his ruination.

The system described is simple as well as satisfactory. Any local authority could use it to advantage. Its success rests on its straightforward attempt at full understanding based on clearly drawn and fairly interpreted specifications and on carefully kept records and written orders.

During the six years this system has been in operation in an important city, only one dispute has arisen as to payment for extra work, and in that case the system was fully vindicated, as the contractor abandoned his claim on the advice of his attorney. This is an impressive record and convincing evidence of the worth of the system described.

## A ZONING GUIDE

The United States Department of Commerce, Washington, D. C., in response to the needs of over sixty cities in which zoning is now in effect, and of over 110 cities which have zoning ordinances in preparation, has just issued a Selected Bibliography on Zoning. This contains critical references to the most important published articles on the subject. Special sections are devoted to the arguments for and against zoning, to the legal aspects of zoning, and to such technical matters as the relation of city planning to zoning, the different types of districts, and agencies and administration for zoning. The bibliography may be obtained by application to the Division of Building and Housing.

# HANDLING "EXTRA WORK" CHARGES ON CONSTRUCTION CONTRACTS

*By W. Earl Weller, City Engineer, City Hall, Binghamton, New York.*

Owing to a deep seated conviction among engineers that contractors will take advantage of any extra work provision in a contract, and owing to the even deeper seated conviction among the public at large that extra work is indicative at best of carelessness on the part of the engineer, extra work has grown to be the *bete noir* of all engineering construction. That this condition is unfortunate in its influence, on public work especially, and that it should be corrected all municipal engineers will admit. Perhaps they will not so willingly admit that the remedy lies wholly in the engineer. Such, however, is the fact.

The problem for the engineer in this case is a double-barreled one. First, he must convince himself as to the unvarying truth of that fundamental economic precept that "we pay for whatever we get"; and second, he must devise a system of extra work accounting that will be both simple and accurate. It is the first of these considerations that is the real stumbling block, although engineers are most likely to hide behind the plea that it is impossible to find a system of accounting that will be simple enough for the average time-keeper or inspector and yet accurate enough to be dependable.

### *Author's Conclusions With Respect to Extra Work*

Not being blessed with the mind of an advocate, the writer will dismiss the first and most difficult part of the problem with a mere statement of a few conclusions that he has reached and on which he hangs his whole policy as regards extra work. The following sentences therefore embody the belief of the writer and are more or less in the nature of a creed. Each sentence might begin with a credo but that would scarcely suit an engineering discussion. However, the writer does believe implicitly as follows:

First: That contracting is a legitimate and honorable type of business and that a contractor is entitled to a fair profit on his sales.

Second: That a contractor cannot in common fairness be expected to know more about a piece of work on which he is bidding than the engineer who designed it.

Third: That the drawing of plans and specifications so exact as honestly to eliminate any unexpected work is a useless waste of time, effort and funds.

Fourth: That general clauses in a specification which may be stretched to cover conditions that the engineer did not definitely know existed are neither good engineering nor good sportsmanship.

Fifth: That the engineer is in no way concerned with the methods used by the contractor but only with the materials used and results obtained.

Sixth: That the real test as to whether or not disputed work is "work evidently not contemplated by this contract" is whether or not the engineer himself really foresaw the contingency and gave

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**EXTRA WORK ORDER**

**Order No.** **Inspector** **Date**

.....

.....

**In connection with your work on**.....**you are hereby**

**directed to**.....

.....

**You will be paid for this work under Sec.**.....**Page**.....**of your contract with the City.**

.....

**Deputy City Engineer.**

Form 501

FIG. 1—FORM FOR ISSUING WRITTEN ORDER FOR "EXTRA WORK" ON BINGHAMTON, N. Y., CONSTRUCTION CONTRACTS.

the contractor the opportunity to include the cost of the work in his bid.

Seventh: That the engineer who has the reputation of being unfair ("strict"—engineers prefer to call it) in his interpretation of extra work pays more in the end than the engineer who has the reputation of playing square.

*Simple and Satisfactory Accounting System on "Extra Work"*

These rather dogmatic statements are submitted without proof or argument. The second consideration of the main problem; that is, the devising of a satisfactory accounting system for extra work, is very simple and the following description of a system which has been in successful operation for six years may perhaps be taken as sufficient proof of this simplicity.

not include any charge for the use of tools, superintendence, engineering, or the like. In case of extra work an extension of time will be granted as provided in the case of alterations."

*Extra Work Written Order*

This paragraph is scrupulously followed and contractors have come to recognize that they must have a proper written order for extra work if they expect to be paid for the work. Extra work orders on a proper form (See Fig. 1) are issued in triplicate for any extra work that may seem necessary or desirable. For each job the orders are numbered consecutively, are dated and are directed to the contractor. One copy of the order is retained in the office, the second copy is given to the contractor and the third copy to the inspector.

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LABOR

| No. Men | CLASS | HOURS | RATE | AMOUNT | |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Nature of Work.....
Street.....
Order No.....
Date.....

EXTRA WORK REPORT

Form 401

FIG. 2—FORM FOR DAILY REPORTING LABOR ON "EXTRA WORK," BINGHAMTON, N. Y.

The standard contract form of the City of Binghamton includes the following clause—"Extra Work. The party of the second part agrees to do all extra work that may be ordered in writing by the engineer. In this connection 'Extra Work' shall be taken to mean work evidently not contemplated by the contract. The Contractor shall accept as his compensation for such extra work the actual cost of the said work plus 15 per cent, for profit, use of tools, etc. The 'actual cost' of the work shall be taken to mean the cost to the Contractor of the labor and materials actually entering into the work, togetherwith the cost of all insurance on such labor and an allowance or rental for such machinery as may be used in the work. The 'actual cost' of the work shall

*Extra Work Report Form*

Any work performed under an extra work order is reported each day on an extra work report form (See Figs. 2 and 3). This report embodies the number of the extra work order, the date the work was performed, the name of the job and the nature of the work, as well as an itemized statement of all labor and material entering into and chargeable against the order. It must be borne in mind that one extra work report covers only the work done under one extra work order and on one working day. If five pieces of extra work have been authorized on one job and the contractor's forces had done some work on each of these orders during any one working day the Engineer's office will receive five extra work

reports covering the five separate orders. Each of these extra work reports must be signed by the contractor or by his responsible superintendent and by the Inspector before they are forwarded to the office. When the work covered by any extra work order is completed the inspector notes the completion on his regular daily report and forwards to the office with the last extra work report his copy of the extra work order. This informs the office that that order is complete and in shape to be checked and entered on the proper estimate forms for payment.

*One Dispute in Six Years*

During the six years that this system of accounting for extra work has been in use in Binghamton there has been but one dispute over payment for extra work. In that instance the contractor claimed that he was underpaid to the extent of some $300 and presented his time books and bills to substantiate his claim. The Bureau of Engineering was in a position to show signed extra work reports covering the work, indicating an expenditure of approximately $400 instead of the $700 claimed. Acting on the advice of his lawyer, the contractor accepted the amount shown on the extra work reports, thereby closing the incident to the entire credit of the system.

Extra work orders and extra work reports are printed on sheets having a distinctive color and of the same size as the standard specification sheets and other report forms. This size is so chosen that the inspector can carry the forms in a suitable binder which will fit readily into his pocket. The system surely answers all conditions imposed by convenience and simplicity and the mere statement of the fact that it has operated successfully for six years seems the best recommendation as to its accuracy.

Approved.....City Engineer

Signed.....Inspector

Signed.....Contractor

**MATERIALS**

| Quantity | KIND | PRICE | AMOUNT | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

FIG. 3—FORM FOR DAILY REPORTING MATERIALS USED ON "EXTRA WORK," BINGHAMTON, N. Y.

## ENGINEERS CONDUCT SUCCESSFUL EDUCATIONAL BOND CAMPAIGN

*By Robert E. McDonnell, of Burns & McDonnell Engineering Co., Consulting Engineers, Interstate Bldg., Kansas City, Mo.*

After the failure in 1921 of the $11,000,000 water bond project for Kansas City, The Engineers' Club of Kansas City conceived the plan of conducting an educational campaign in a further effort to carry the bonds, which were urgently needed for a new filtration works, two pumping stations, larger feeder mains, reservoirs and other work. The President of the Engineers' Club is Alexander Maitland, Jr. He is also Chairman of the new Water Commission. This bi-partisan commission of four men was elected in 1921 to handle the entire new construction and also to operate the present works, thereby removing it from political control. As many engineering questions were involved, it was thought proper to have the Engineers' Club present engineering facts, figures, costs and other data before the 170 civic organizations so that the public could intelligently vote on the project.

Mr. Maitland, President of the Engineers' Club, appointed a water committee

of eleven engineers, with Mr. R. E. McDonnell, Consulting Engineer, as Chairman. This committee arranged its subcommittees on: Statistics, Filtration, Fire Protection, Typhoid, Present Works, Ozark Supply, Missouri River Supply, Publicity, Speakers, etc., and proceded to collect and assemble diagrams, data, stereopticon slides, newspaper articles and other information for use before civic and community meetings.

Preliminary to the campaign, a successful effort was made to eliminate all other bond projects, for at the former election defeat was due in a large measure to having eighteen other bond projects up for voting along with the water works. A City campaign was in progress and before political platforms were made public, the leaders of each party were induced to insert a plank favorable to the water works.

After nomination the candidates were pledged to support the bond project.

Prizes were given for water bond slogans; some presented were: "Water the Town and Watch It Grow," "Millions for Water Means Water for a Million," "H2O Let's Go." These were put in windows and upon wind shields of automobiles. The Engineers' Club discovered that its membership contained many speakers of ability and illustrated talks were given before about 60 of the larger civic organizations. The campaign was also conducted through the schools by talks, first before all the teachers of the City, then before High Schools and Civics Classes. Several thousand High School and Grade School students themselves made four-minute talks upon the water works needs at classes and four-minute talks upon the water works needs before their parents at their homes.

A feature of the proposed improvements was filtration and the typhoid rates of cities with filtered water were compared with that of Kansas City, which was found to be the largest city in the United States using river water without filtration. Diagrams and statistics were circulated at meetings, showing the health improvement in other cities after filtration.

The partial water softening proposed in the new plant was a campaign hit and was made effective by the speakers giving soap demonstrations with soft water and with the hard water. It was shown that the saving in soap alone would pay the entire bond interest. Demonstrations before audiences of women were both convincing and effective by showing the results of using hard water and then soft water, in washing linens, laces, lingerie, etc.

Records were secured of the people voting at the 1921 election and it was found that only from 7 to 8 percent of the membership of civic organizations voted at all. The voting record of each civic club at the previous election was publicly presented, much to their embarrassment and humiliation, for it was found that the clubs were strong on civic duty but sadly delinquent when it came to voting. This feature of the campaign was effective in getting out a large vote.

The results of the campaign showed a vote of over 40,000 majority and as a direct result it was found that in one ward where the water works subject was specially well covered, the vote was 8 to 1 for, while in wards without talks, the bare majority vote was secured.

One beneficial result to the Engineers' Club was the bringing of the engineers prominently before the public in a worthy civic duty performed in behalf of their city.

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# ESTIMATING COST OF HIGHWAY BRIDGES

*By Walter S. Todd, Assistant Bridge Engineer, Illinois Division of Highways, State House, Springfield, Ill.*

A good estimate is one which approaches very closely to the actual cost of construction, with a fair profit to the contractor included. In order to secure accurate estimates, actual cost records of similar work should be available to the estimator.

There are two factors which have made it difficult to secure reliable estimates on highway bridges; first, the construction of bridges of the types now common, and by the methods now prevalent is comparatively recent, so that cost records are not available which are applicable to present types and methods of construction. Second, the securing of actual costs while construction is in progress involves extra work upon the engineer in charge of the work, and consequently is generally slighted. The time and energy required to "boil down" cost records to a unit basis, so that it may be used on similar work for estimating purposes, is very great. The results obtained, however, are worth the effort and form a basis for estimating.

*Preliminary Estimate.*

There are two kinds of estimates,—preliminary and final, and each has its particular field of usefulness. A prelimi-

nary estimate may be based upon approximate data, but with sufficient information at hand, it should not vary greatly from an estimate which is made after the detail plans are complete. A preliminary estimate may be based upon plans for structures of a similar nature which have already been prepared, or upon standard plans. Curves may be prepared which show the relation between size of structure and volume of material required, and the amount of material required for a given structure quickly obtained from them. The preliminary estimate has three distinct uses. It may be used to determine the most economical span length to adopt for a multiple span structure. It may be used in reconnaissance for determining the most economical route to choose between two fixed objectives, i. e., the cost of earth work, pavement and bridges on one route may be compared with the same items on another possible route. The preliminary estimate permits the determination of the approximate cost of structures without the aid of complete plans. An estimate of this kind is also essential to present a definite basis for a campaign to secure funds to finance construction, and is generally demanded before completed plans are available.

*Final Estimate.*

The final estimate is made after surveys and plans are completed, and should represent the engineer's best judgment regarding a reasonable final cost of the structure to the public or owner. An estimate may be quite accurately made if it is subdivided into the various items of material, labor, transportation, etc., which are involved in the construction. As an example, the following items are covered in an estimate for a reinforced concrete bridge, and each item is given in terms of 1 cubic yd. of concrete in the finished structure: (1) cement equals the number of barrels per yard of concrete multiplied by the sum of the cost of cement f. o. b. nearest station, and the hauling cost from station to bridge site; (2) fine aggregate equals volume of sand per yard of concrete multiplied by the sum of the cost of sand f. o. b. nearest station and the hauling cost; (3) coarse aggregate equals volume of stone or gravel per yard of concrete multiplied by the sum of the cost of coarse aggregate f. o. b. station and the cost of hauling same; (4) form and falsework lumber; (5) labor required in placing forms and falsework; (6) labor required in mixing, conveying and spading concrete; (7) reinforcing steel delivered at the bridge site; (8) labor in bending and placing steel; (9) removal of existing bridge; (10) excavation cost per cubic yard of concrete; (11) incidentals such as name plate, expansion device or brick for hand rails, when used. The sum of these items may then be multiplied by the total yardage in the structure and a percentage added to same to cover liability insurance, profit, contingencies, superintendence and overhead.

It is generally best to add the cost of piling as a separate item, as the cost of this part of the work is not generally accurately known in advance. The contractor may be instructed to submit a unit bid and payment may be made upon the lineal feet actually driven.

*Cost Data.*

It is a comparatively simple matter to determine the quantities of material required for a structure, but the cost of labor is best determined from previous work of a similar nature. These labor costs should preferably be in terms of man-hours, so that variations in labor rates may be easily applied. The bridge office of the Division of Highways of Illinois has kept records of labor costs for a large number of highway bridges of various types which have been built from standard plans. These average costs in terms of man-hours per cubic yard of concrete in the finished structure are given in Table I with the number of bridges of each type from which cost records were taken to obtain the average given. Bridges on which labor items were exceedingly high or low were not included, so that the figures shown give a fairly reliable average under usual conditions for the

TABLE 1—COST DATA FOR REINFORCED CONCRETE HIGHWAY BRIDGES.

| Type of Structure | R. C. Box | Slab Bridge | Thru Girder Bridge | Deck Girder Bridge | Plain Concrete Abutments |
|---|---|---|---|---|---|
| No. of Bridges Considered . . . | 83 | 93 | 48 | 3 | 5 |
| *Man-hours per cubic yard of Concrete* | | | | | |
| Bldg. Forms ... | 4.24 | 4.41 | 4.71 | 7.04 | 2.69 |
| Mixing and Placing Conc. .. | 3.97 | 4.65 | 4.33 | 3.87 | 3.45 |
| Bending and Placing Steel... | 0.68 | 0.75 | 1.51 | 1.24 | |
| *Feet B. M. per Cubic Yard of Concrete* | | | | | |
| Form and Falsework Lumber .....24.20 | | 16.53 | 17.54 | 20.23 | 10.00 |
| *Pounds per Cubic Yard of Concrete* ... .. | | | | | |
| Av. amt. Reinforcing Steel in Superstructure . | 100 | 198 | 230 | 255 | |
| And Substructure ..... | 100 | 44 | 53 | 57 | |

State of Illinois as a whole. The amount of form and falsework lumber required is also shown in the table, but these figures are probably low, as the falsework used was generally green timber cut near the bridge site and was not included in the figures shown.

In Table I all structures considered had reinforced concrete abutments, with the exception of the structures listed in the last column.

In the estimate of the cost of structural steel superstructures, the principle of dividing the estimate into the various labor, material and transportation costs is advisable. The chief items involved, exclusive of floor, in the cost of a steel truss are as follows: mill or warehouse price of structural shapes; freight from mill or warehouse to fabricating shop; fabrication costs, including detail plans, reaming, shop paint; freight from the fabricating shop to station nearest site; unloading and hauling to the proposed site; falsework; erecting; field riveting; field painting; liability insurance; profit and contingencies.

The foregoing paper by Mr. Todd was delivered before the recent Short Course in Highway Engineering at the University of Illinois.

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# MUNICIPAL SANITARY PRECAUTIONS DURING EPIDEMIC OF INFLUENZA

## Rambling Thoughts of a Civil Engineer

PART TWO.

*By Dr. Wm. Paul Gerhard, C. E., Consulting Engineer, 17 West 42d St., New York, N. Y.*

The measures of public hygiene and sanitation, to be instituted by municipalities, which seem to me to be, one and all, worthy of consideration, follow. No attempt is made, in this enumeration, to put them down in the order of their relative importance, for on this point the individual views of experts vary.

Municipal departments (health, police, city engineering and public traffic departments) should hold in readiness well-considered preventive measures. The extent and nature of these necessarily depend upon the character of the community. A rural district, or a small town, obviously, demand a somewhat different treatment than a metropolis.

In all important measures efforts are concentrated upon:

(a) The prevention of droplet infection by sneezing, coughing, spitting, handshaking, etc. Such droplets are scattered about to a distance of several feet, and every drop may carry the germ.

(b) The control of the sputum, the avoidance of hand contamination, and the contamination of eating and drinking utensils (dishes, glasses, cups, spoons, etc.).

(c) Efficient organization, providing for the gathering of facts regarding cases and mortality, and preparing "pin maps" both of cases of illness and of deaths; studying the collected data; requiring notification by physicians; sending sanitary inspectors to follow up the cases reported, making a house-to-house inspection of the entire city.

(d) Careful instruction of the general public, of teachers in schools, of foremen in factories, of superintendents of large department stores, of theatrical managers etc., in nose and mouth hygiene* by means of bulletins, pamphlets and popularly written literature.

(e) Prompt destruction of all infectious matter; warning against a careless disposal of nasal discharges.

Equally important administrative control measures, to be taken at the first outbreak of an epidemic are: the isolation of the sick; the provision of a sufficient number of hospital beds; the avoidance of crowded gatherings, and the efficient warming (in winter) and ventilation of homes, offices, stores, workshops, and means of communication.

These rather general considerations are necessary for a proper understanding of the more specific measures outlined in the following suggestions.

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* Among *Rules for Personal Hygiene*, most of which are not considered in this article I briefly mention:

Avoid people who are coughing or sneezing.

Keep at some distance from persons talking or singing.

Do not attend crowded gatherings, whether indoors or outdoors.

When obliged to cough or sneeze, cover nose and mouth with handkerchief.

Avoid the promiscous use of handkerchiefs, towels, napkins. Also shun roller towels, soap in cake form, drinking cups in public places.

Never use cup, glass or dish used by others unless utensils have been washed and sterilized.

Wash hands before eating, and after handling pencils or other articles used in common.

Work, live and sleep in well-ventilated rooms.

Keep the feet dry, the body warm, avoid physical or nervous exhaustion.

Take moderate daily exercise; regulate the hours of sleep.

If you become unavoidably exposed, and are threatened with the "flu," go at once to bed. Stay in bed until the fever subsides, in order to avoid a relapse or later complications.

### *A. POLICE AND HEALTH BOARD REGULATIONS*

1. *Anti-spitting Ordinance.*—Pass an anti-spitting ordinance, making spitting in public places or on the street, a punishable misdemeanor. Provide an adequate force of sanitary inspectors, or policemen of the sanitary squad, to enforce the ordinance.

2. *Placards Regarding Use of Handkerchief.*—Put up placards, printed in large letters, in public buildings, on prominent street corners, on public squares and in public conveyances, warning the public that there must be no "open" or unguarded coughing or sneezing, and recommending the use of a handkerchief, or some suitable substitute, when sneezing, coughing or expectorating. This measure is recommended in order to smother a cough or sneeze which may contain the germ. Make it a misdemeanor to do this in public without covering up mouth and nose with a handkerchief or paper napkin.

NOTE—The health bookmarks sent out by the Department of Health of New York City some years ago, some of which had printed on them warning tell-tale illustrations as to the use of a handkerchief, are to be recommended.

3. *Use of Suitable Substitute for the Handkerchief.*—Urge the use of strips of cheese cloth, or cheap muslin, or of paper towels or napkins, in place of handkerchiefs, and recommend destroying them after use by burning, this being vastly better than sending infected handkerchiefs to a public laundry. Print such warnings in the daily press. Distribute leaflets to this effect in dwellings, apartment and tenement houses, in stores, factories, drugstores, etc.

4. *Prohibit Common Drinking Cups and Roller Towels.*—Common drinking cups and roller towels should be strictly prohibited. Where they still exist, their use should be avoided.

5. *Visitors to Sick in Hospitals.*—Permit no visitors in the city hospitals. Where an exception to this general rule is granted, the visitor should be made to wear a suitable new face mask. (See under 11.)

6. *Placard Houses.*—All houses where cases of influenza occur should be placarded by red cards, printed in bold-face type.

7. *Funerals.*—All public funeral services should be prohibited. The attendance at home funerals should be limited.

8. *Hand-shaking. — Moistening fingers When Touching Articles.*—The advice of the Health Commissioner of Chicago to refrain from hand-shaking during an epidemic appears to be sound. The practice of moistening the fingers by the lips when counting bills, or turning pages of library books in public reading rooms, or when wrapping up articles in packages should be avoided. Kissing should, as a matter of course, not be indulged in.

9. *Limit Hours of Work. Early closing.*—Limit the working hours in department stores, also in factories. Prohibit advertised "bargain sales" as being apt to draw large crowds of shoppers. Enforce the early closing of other stores, such as barber shops, shoe-cleaning establishments.

10. *Distribute or Stagger the Traffic.*—Lessen the danger of transmission of disease through the overcrowding of cars. A very excellent measure, designed to distribute traffic during morning and evening rush hours, was introduced in 1919 by the Health Commissioner of New York City. It consisted in arranging for slightly varying hours not only for opening and closing of large stores, factories and offices of large corporations, but also of the theaters and places of amusement. By enforcing this measure the traffic was staggered and the overcrowding of cars on subways, elevated and surface lines efficiently prevented.

NOTE—Incidentally, this measure would prove in large cities at all times the best possible solution of the intricate problem of traffic congestion.

In the smaller communities it would probably be better to discontinue temporarily during the epidemic all trolley service.

11. *Face Masks.*—During the influenza epidemic of 1918-19 one preventive measure was introduced, which was a novelty for the layman, although it had been used before in hospital practice. This was the compulsory wearing, by nurses, physicians, hospital attendants and patients' visitors, of gauze face masks, protecting the mouth and nose. The police of New York City, likewise, had orders to wear face masks, when duty called them to houses in which there were cases of influenza. Barbers, dentists, manicures and street sweepers might also adopt the measure. On the other hand, the obligatory wearing of masks by the entire population, as in San Francisco and other places, did not produce the expected results.

Face masks, to be a true protection, should be both properly made and rightly put on. There is, obviously, danger in using them promiscuously. Frequent ster-

ilizing by boiling is a necessary condition. The general use is not only impracticable, but it is a decidedly insanitary measure.*

*B. PUBLIC CONVEYANCES.*

12. *Cleaning and Disinfecting of Cars.*—The cars of all transportation lines, whether surface, subway or elevated cars, should be cleaned and disinfected every night, for they may accumulate pathogenic germs. Public coaches and cabs for hire should be included in this rule. They must be kept scrupulously clean, and should be disinfected when patients have been taken in them to the hospitals.

13. *Keep Car Windows Open.*—Cars of transportation lines should have some windows always open, for better ventilation, weather permitting. The public should be warned to travel in public conveyances as little as possible. Advise persons to walk daily from their homes to the places of work, long distances excepted.

*C. PUBLIC GATHERINGS*

14. *Limit Size of Public Gatherings.*—Public gatherings may become the direct agencies for the transmission of disease, hence it is advised to limit their size, to prohibit gatherings altogether if unimportant, and to provide plenty of fresh air and sufficient floor space per person in permitting meetings. In Chicago the police force had orders to disperse street corner gatherings.

15. *Lodge Rooms, Fairs, Exhibitions, etc.*—Close up places of assembly, like lodge rooms, also public fairs, exhibitions, and open-air meetings, where speaking or singing takes place. Postpone dates of conventions. Close up pool rooms, saloons dispensing soft drinks, ice cream and soda fountain parlors, because of danger of spread of the disease through the imperfectly washed drinking utensils, which may become infected. The sterilizing of glasses may not prove a sufficient safeguard.

*D. PUBLIC BUILDINGS*

16. *Schools.*—The question as to the desirability of closing public and private schools when an epidemic of influenza threatens is an important one, but it is also debatable. Able sanitarians, on one side, argue it is better to keep schools open, and to exercise supervision over the pupils by a careful examination on arrival, by either a school nurse, or a medical inspector. They consider the closing of the schools a danger to the children, because these will then congregate in the street, or in halls of tenement houses, which are not under observation.

Others, equally competent, argue that schools should be closed, because the compulsory attendance necessarily increases the close contact between school children. In the case of public schools, urban and rural conditions differ considerably, and at least in the smaller communities, and in country districts the closing of the schools should be favored.

Where in large cities schools are kept open, the daily inspection of the pupils, the practice of "air flushing" of class rooms, and the sending home of pupils who constantly sneeze or cough should be observed. The law against the use of common drinking cups and roller towels in schools should be enforced.

17. *Colleges.*—Colleges and private boarding schools may institute a mild quarantine against the outer world during an epidemic.

18. *Theaters and Moving Picture Shows.*—Some opinions notwithstanding, I hold that performances in theaters should be stopped, and moving picture shows closed, for the suggestion of keeping attending persons under "close observation," and to "eject careless coughers," seems to be utterly impracticable.

19. *Other Places of Amusement.*—Dance halls, skating rinks, bowling alleys and billiard parlors should be closed because of danger of crowding and too close personal contact. Lectures, concerts, banquets, conventions, and athletic meetings should be very much restricted.

20. *Churches.*—While the suggestion to close up churches during an epidemic may not meet with universal approval, the services can and should be reduced to the lowest possible number. The fonts in Catholic and in Baptist churches should be dispensed with during the epidemic or, if they must be retained, the water should be frequently renewed and sterilized.

21. *Court Houses.*—While the business of courts should be interfered with as little as possible, it may become necessary to close up the court rooms.

22. *Railroad Stations.*—The sanitation of railroad stations requires prompt attention, for such buildings form assembly places for numerous travelers, and the history of epidemics points to the fact that the railroad lines form a principal agent concerned in the spread of disease.

Railroad waiting rooms (and those of trolley lines) should be well ventilated, kept clean, and the floors scrubbed and

* The conclusion of experimental observers is that "face masks have not shown a degree of efficiency to warrant their compulsory application for the checking of an epidemic."

sprinkled daily with some disinfecting solution. Floor sweepings should be safely disposed of or burned.

For drinking water, individual paper cups, or else bubble drinking fountains with parabolic stream should be provided. The toilet rooms should be daily looked after, and the plumbing installation kept in a sanitary condition.

23. *Public and Circulating Libraries.*—It is debatable whether in an epidemic it would not be wise to close up at least the circulating departments of public libraries. Books from public and from private circulating libraries may carry and distribute the illness by droplet infection, if returned by persons slightly ill with the disease. The disinfection of the returned books should be considered, but it is not easily put into execution.

24. *Dental Offices, Barbershops, etc.*—It is self-evident that proper attention should be given by the health authorities to such places as dental offices, barbershops, beauty parlors and manicure establishments.

25. *Restaurants, Bakeries, etc. Food Stores.*—Close up any places where food or beverages are handled or sold under unsanitary conditions, or where cooking utensils and table dishes are not kept scrupulously clean.

Door knobs of food stores, such as groceries, bakeries, meat and fish markets and stores, also butter and egg stores, and the like, should be washed daily with a disinfecting solution (suggest use of HYCOL, of Merck & Co.).

*NOTE—Unsanitary Dish-washing—*
In public eating places, hotels and restaurants, and in public institutions two methods of dish-washing are practiced, viz
(a) washing by hand;
(b) washing by machines.
In method (a) dishes are not sterilized, because the temperature of the hot water cannot be higher than the hands can stand (about 115 to 120° F.). Method (b) is far better, as a scalding temperature of the water can be used in the machine. The method is not only more effective, but more economical. According to Lieutenant Col. Cummings' (Berkley, Cal.) investigations in army camps and in civilian institutions, a much smaller number of cases of influenza and pneumonia occurred where dish-washing machines were in use.

The use of paper dishes, spoons, cups, etc., during an epidemic is recommended, as also the destruction of such utensils after meals by burning. If not so destroyed, they should be disinfected.

Food displayed in eating places and bakeries should always be properly protected.

26. *Public and Commercial Laundries.*—Public and steam laundries should have their sanitary condition inspected. Special care should be used in keeping clean and soiled linen separate. Bedding, soiled handkerchiefs, towels and napkins, when received at laundry, should at once be put into boiling water, or into a sterilizing and disinfecting solution.

In some cases it may become advisable to put laundries under municipal control, or to take them over temporarily.

In Calcutta, during a recent influenza epidemic, the health officer advised disinfecting handkerchiefs, towels, etc., in a 1 per cent. solution of Hycol disinfectant.

Ironing the wash is of some value in killing germs.

27. *Stables and Dairies.*—Strict attention should be given to the sanitation of all city stables, and of milk plants, located within the city limits.

As a suitable disinfectant, Lysol, Beta-Lysol, Hycol and Sterilac (Abbott Laboratories, Chicago) are recommended.

28. *Public Bathhouses; Swimming Pools.*—Public swimming pools should be closed up until the end of an epidemic, but the individual rainbaths or showers may be kept open. Provide the attendants with a disinfecting soap, to be distributed to the bathers.

29. *Public Comfort Stations.*—Public comfort stations should be inspected, cleaned daily with particular care and disinfected. The water closet and urinal flushing pulls, as well as handles of flushing valves, should be washed daily with a disinfecting solution.

30. *Lodging Houses.*—Enforce the maintenance of cleanliness in all lodging houses. Have them frequently inspected and the dormitories and toilets disinfected.

### *E. STREET SANITATION*

31. That street dust is a carrier of disease germs is well known. Accordingly, even at ordinary times, street sprinkling should be practised to lay the dust; this is rendered more effective by applying to the surface a treatment with calcium chloride (Dow's Dowflake or Semet-Solvay's chloride) to keep the surface damp. It is claimed that this is more economical than sprinkling with plain water.

During an epidemic streets should be sprinkled with a disinfecting solution in water (Hycol or Beta-Lysol might be used).

Street gutters and catch basins at street intersections should be carefully examined, swept, flushed and kept scrupulously clean by the force of the city engineering department.

Cities having alleys in the rear of lots should have these well cleaned up, and

all rubbish and organic refuse should be promptly removed.

Property owners and householders should be made to keep sidewalks and footways clean and free from dirt and rubbish, and this should also include the street gutters.

All these measures suggested might prove to be a material help in stamping out the epidemic, for they would prevent pedestrians from carrying street dirt and possibly germs on the shoes into their homes, and into carpets and rugs.

*F. DUSTING AND CLEANING*

32. School rooms as well as court rooms should, if kept open, be dusted by means of dustless cloths and mops. The use of feather dusters should be prohibited. The sweeping of floors should be done with windows wide open. The use of a disinfecting solution in the mopping up of floors is recommended.

Carpet and rug beating and shaking from the windows or in back yards should be entirely prohibited. Such floor coverings may harbor germs of disease, which would then be scattered broadcast.

Mouthpieces of public telephones should be kept clean, wiped and disinfected, notwithstanding the telephone company may consider such measures to be superfluous. Wherever possible, avoid using a public telephone booth during an epidemic.

*G. BANKS AND PAPER MONEY*

33. Money, coins as well as bills, continually passing from one person to another, are likely to become the carriers of disease germs. Especially is this suspected of old, worn and dirty paper money. This view, however, is not universally entertained; some disbelievers point to the vast amount of dirty paper bills handled daily by employes of the United States Treasury Department without their becoming infected.

Opposed to this view might be cited the easily verified fact that many banks provide sponges dipped in a germ-killing solution to protect those employees who handle and count money, from infection.

Some years ago, Dr. Parke, of the New York Health Department, found disease-carrying germs on coins; another bacteriologist counted on one bill more than 140,000 bacteria. More recently, bacteriologists of the University of Illinois found old bills laden with germs. If coins carry less germs, this may be due to the metal (copper, nickel) acting as a bactericide.

During an epidemic persons should be warned against the unsanitary practice of holding any money in the mouth, and of licking postage stamps, which also gather bacteria.

During an influenza epidemic, banks should make an effort to issue only clean and new paper money. The writer suggested this in 1919 to the Surgeon-General of the United States Public Health Service. Unfortunately, at that time there was a shortage of paper, and he was told that the United States Treasury Department was unable to comply with the suggestion.

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## FEATURES OF SEWAGE DISPOSAL PLANT AT RANDOLPH, NEB.

*By Keyes C. Gaynor, Consulting Engineer, 525 Trimble Bldg., Sioux City, Iowa.*

The small towns, that is, communities from 500 to 2,000 inhabitants, in the middle west often have problems in sewage disposal that are in some ways more difficult to solve than the sewage disposal problems in large cities.

In the first place, these towns are prairie towns and the location for the town was chosen because it happened to be so many miles from some place else and made a convenient place for a railway station. Therefore, the town is often devoid of any water course within the immediate vicinity. Sometimes there is not a stream within several miles. In many other places the country is very flat and it is necessary to resort to pumping to get rid of the sewage at all.

Another difficulty in designing a plant for a small town is that it has to be self-operating. They are usually turned over to the Town Marshal or Street Commissioner to look after, and the average Street Commissioner in a small town has many other things to do and so the sewage disposal plant usually comes in for very scant attention.

These small communities are further handicapped by the fact that they have not sufficient finances to carry on the work, or if they have sufficient finances they do not want to use them for the purpose of sewage disposal.

Although the construction of a sewerage system and a sewage disposal plant is one of the most necessary improvements in these communities, on account of the fact that so many of the people use wells in their yards for their drinking water, I have found that a city council has more difficulty in carrying through an improvement of this kind than any other public improvement which they might under-

take. Street lights and paving, on account of their visibility, are much easier for a city council to install.

*The Problem*

An illustration of the problems met with in sewage disposal in small towns is the problem of the town of Randolph, in northeastern Nebraska. Randolph is a town of about 1,200 people. A part of this town is situated in the valley of a small creek, which in normal times is 1 ft. deep and 3 ft. wide. It was just barely possible to drain a considerable part of the town, which is built in the valley, into this creek. However, on account of the smallness of the creek, it was inadvisable to empty the sewage directly into it, and on account of floods in the spring time it was rather difficult to put in a disposal plant, including filters near the creek so that the flood waters in the spring would not overflow into the plant.

Furthermore, when this job came to me the town had already voted bonds for the work and the bond issue was for only $6,000 and the council felt that it would be necessary to build this disposal plant so that it would not cost to exceed the amount of the bond issue.

*Elements of the Plant*

The plant at Randolph consists of a pump cistern or sump into which the sewage flows from the town. From the sump the sewage is pumped into an Imhoff tank and from the Imhoff tank flows into an accumulation chamber, from which it flows onto a rock filter.

The distinctive features of this plant are—first, filters, settling tank, sludge bed and pump sump are all raised up high enough to prevent the overflow of flood waters from the creek in the spring. Another feature in which this plant differs from other plants is that the whole plant is periodical in its operation and there are no siphons. The sewage accumulates in the sump and an automatic switch operated by a float in the sump starts the motor which operates the pump when the sewage rises to the elevation of the inlet pipe.

The raw sewage then starts to flow into the settling basin at one end, and the settled sewage, on account of increased head, starts to flow out at the other end.

VIEW OF SEWAGE TREATMENT PLANT AT RANDOLPH, NEBRASKA.
Pump Sump on Left, Settling Tank in Center and Sprinkling Filter Bed on the Right. A Sludge Bed Lies Directly Back of the Settling Tank.

The size of the pump pit and the size of the accumulation chamber at the discharge end of the tank has been so arranged that when the pump starts the accumulation chamber is empty and there is nothing flowing onto the filter beds.

The rate of pumping is also arranged so the pump will pump twice as much sewage as the nozzles will discharge so that when the pump starts the sewage begins to flow into the accumulation chamber and onto the filter beds, because the pump is pumping twice as fast as the nozzles can discharge the sewage. The sewage accumulates in the accumulation

chamber and builds up a head of about 8 ft. on the nozzles. On account of the balance of sizes of sump, accumulation chamber and nozzle capacity, the sump will be empty at about the time the maximum head occurs in the accumulation chamber, and, of course, when the sump is empty the pump automatically stops, and the head on the nozzles again falls to zero. In this way a variable head is obtained at the nozzles, thus giving a complete distribution of the sewage on the filters.

I have no information as to the exact percentage of purification in this plant, but I do know that the effluent from the filter bed is clear and has no odor and no taste and there has been no complaint from the farmers living along the creek since the plant was put in operation.

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## OHIO BOULEVARD EXTENSION AT TERRE HAUTE, INDIANA

*By George J. Stoner, of Shourds-Stoner Co. Inc., Architects and Engineers, Chicago,, Ill. and Terre Haute, Ind.*

The City of Terre Haute, Ind., this year is securing a valuable addition to its park and boulevard system by the construction of an extension of Ohio Boulevard, one of the pioneer drives of the city from 25th Street Eastward one mile to Fruitridge Avenue, the Western boundary of Deming Park.

This was made possible by the splendid gift of Mr. Demas Deming, pioneer banker and realtor of the city, who but recently passed away just as the actual work of construction on this, his last living beneficence to his city was being started.

Last year Mr. Deming offered to the Park Board of Terre Haute a beautiful rolling site of about 155 acres situated on the east bluffs of the Wabash river, just beyond the present city limits for a sum of $155,000, Mr. Deming agreeing to expend this money as follows: One Hundred Thousand Dollars to be given as an endowment to Rose Polytechnic Institute, a technical college of high standing which institution is rebuilding at the present time on a new site several miles east of Terre Haute, and the remaining Fifty-five Thousand Dollars on the Extension of Ohio Boulevard for a distance of one mile to the entrance of the new Deming Park. The Park Board at once accepted this munificent offer and the firm of Engineers of which the writer is a member were commissioned to prepare plans and specifications for the grading and opening of this boulevard and for its improvement with gravel pavement, concrete sidewalks, curb and gutters.

When completed this promises to be one of the most handsome drives of the State. It will be 195 feet in width from property line to property line with two drives each 30 ft. in width and a center parkway 80 ft. in width. Sidewalks 6 ft. wide are set out from each property line a distance of 5 ft. to allow sewer connections later without any cutting of walks or roadways. A tree strip 14 ft. in width, gently sloping to the curb, offers ample space for the growth of trees without danger of the heaving and breakage of curb and sidewalks from roots, which is found so often.

The center parkway is to be 80 ft. in width allowing two rows of trees and space for flowers, shrubs and bushes. It is to be graded to an elevation of 1 ft. above curb line at the center, sloping uniformly at each side. At intersecting streets the curb is curved using a 25 ft. radius and this with the street width of from 60 to 65 ft., gives a delightfully wide expanse for traffic.

The territory traversed is practically all high of a sandy loam with a splendid grade of clean gravel lying from 3 to 8 ft. below the surface. The proximity of the gravel, of course, allows the improvements to be made at a much lower cost than in ordinary conditions. The grades range from a minimum of three-tenths per cent to a maximum of two and one-half per cent on the hill at the western extremity. They are computed in so far as possible so that the lots on both sides will be from 6 ins. to 2½ ft. above the sidewalks without any additional grading, the total yardage being for cut 27,000 cu. yds., and for fill, 36,000 cu. yds.

The drainage of the sub-grade is naturally perfect, due to the nature of the soil and the grades, excepting in one place. In this place a low, flat, swampy piece of ground extends for about one quarter mile on each side of the boulevard with scarcely any difference of elevation. The subgrade drainage in this stretch of about 400 ft. is being taken care of by intercepting ditches filled with coarse gravel.

The city sewer system does not as yet extend to this territory and as Terre Haute is now in the situation where it finds itself confronted with the necessity of a complete rehabilitation and extension of its trunk and belt sewers in a very few years, the problems encountered in a design of this boulevard extension

was to provide proper surface drainage for the first 2 or 3 years and also to provide for connection at a minimum cost to the municipal sewerage system when built. Consequently cast iron curb and gutter type inlets are being installed at the proper places at the present time and may be connected up at any future time to the tearing up of any concrete work or without stopping traffic on the thoroughfare.

The present or old part of Ohio Boulevard extends from the heart of the business district through some of the highest class resident districts of the city, districts which are protected by all possible restrictions so as to provide desirability as a home district. The extension besides providing a boulevard to the new Deming Park, also opens up 16 blocks of high grade residence property and passes within 2 blocks of Edge Wood Grove, another high-class residence suburban district and the old County Fair Grounds recently converted to a city park and a place where the proposed municipal stadium for all public sports, scholastic, amateur and professional are to be held. It will provide an automobile traffic entrance through Deming Park and along Ohio Boulevard to the heart of Terre Haute from the National Road, a highway which at the close of 1922 will probably be entirely paved from Columbus, Ohio to St. Louis, Mo., and over which thousands of auto tourists annually travel, very similar to the entrance from the south to Chicago through Jackson Park, the Midway, Washington Park and Michigan Boulevard, and marks the real beginning of Terre Hautes' Park and Boulevard Developement.

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## OILING ROADS IN JACKSON COUNTY, MISSOURI

*By Leo. E. Koehler, County Surveyor and Highway Engineer of Jackson County Court House, Kansas City, Mo.*

Road oils in the past have been used to great advantage for the laying of dust, but experience has taught us that good road oils may not only be used as a dust preventive, but may also be used as a protective cover which will prevent disintegration of the roads, from fast traveling vehicles and also from weather conditions.

In Jackson County we have a chain of some 250 miles or more of water-bound macadam roads which constitute the main arteries of our system and from them radiate the by-ways, or lesser traveled roads. Experience has taught us that the use of even the best of road oils is not advisable on thees macadam highways, and it is our opinion that a bituminous binder in the form of a mat coat is preferable, in face of the fact that the initial cost is greater; therefore, I will eliminate the above mentioned rock roads from my remarks and proceed with the oiling of dirt roads.

### *Oiling Confined to Dirt Roads*

The use of oil on our dirt roads is saving the farmer many times their cost in transporting his products to market, to say nothing of the pleasure of driving over good roads. It encourages the farmer to trim up and otherwise improve his farm—adds to the beauty of the country and to the value of the land.

In Jackson County we have been using oil on dirt roads for several years, with more or less success; as we have studied and experimented we find a great and varied difference in road oils. The first oil, "I am reliably informed," in use here was from 24 to 30 Baume gravity, no mention of asphaltic contents being made. That oil was beneficial as it laid the dust and somewhat shed the water, but being of a light volatile substance it soon evaporated and it was found that the greatest good from that class of oil was obtained by saturating the road in the late fall and this did help to keep the farmer out of the mud during the winter.

### *Three Essentials to Success*

Later experiences have demonstrated to us, that three things are absolutely necessary for the construction of a good oiled dirt road:

1st. Road must be put in proper condition to be oiled.

2nd. The proper kind of road oil must be used.

3rd. Oil must be applied properly and at the proper time.

### *Preparation of the Road*

In discussing requirement No. 1, will say that my greatest trouble in the shaping of a road is with inexperienced help as road builders. We are blessed in this county by an antiquated system of road overseers appointed by the County Court; very frequently not for their knowledge of road building, but for the reason that they are good vote getters, and have little or no interest in good roads. These esteemed gentlemen, of whom I inherited 59, had previously been instructed that the crowning of the road was the most important factor in the shaping of it, and

they proceeded to shape the road like a hip roof, thereby causing all the travel to go to the center, straddling the ridge so as to not skid into the ditch, which they invariably did when it became necessary to pass someone on the road.

The old saying, "It is hard to teach an old dog new tricks," was true in our case, and inspite of all we could do or say, many of our oiled dirt roads are overcrowned, which causes a dangerous condition in slippery weather.

Our idea of the proper shaping of a dirt road for the receiving of oil is as follows:

The road must be thoroughly ditched and all loose material removed from the roadway to be oiled. Always grade the roadway from the center, pushing the loose material to the outside quarters; here is where a good blade machine man is to be appreciated, as a poor man can do more damage with a blad in one day than can be corrected in several days. The surface of the road should be as solid and free from loose earth as it is possible to make it and should be crowned only enough to cause the water to flow to the ditches, and in this connection will say that it is much better to have the road too flat than over crowned, as on a flat surface the travel is more evenly distributed over the entire surface thereby causing longer life to the road and more safety to travel. Most roads in this section have a longitudinal grade which will take care of the drainage with a very slight crown. A draw always working from the center towards the side of the road should be used after grading is finished.

*Proper Kind of Oil*

It is very essential that oil for dirt roads should be as near non-volatile as possible, should contain not less than 60 to 70 per cent asphalt and as great a percentage of saturation as possible. The method of refining has much to do with the saturation, volatilization and quality; therefore, we deem it highly essential that a chemical analysis of the oil to be used be made before it is applied, as many of the oils offered are nothing more or less than fuel oil, which will not give satisfactory results.

*Application of Oil*

This also is very important and it is here that the man in charge of an oiling crew is of great importance, as it is his judging that will determine the amount to be applied and if the road is in shape to receive the oil, and if weather conditions are such that oil should be applied.

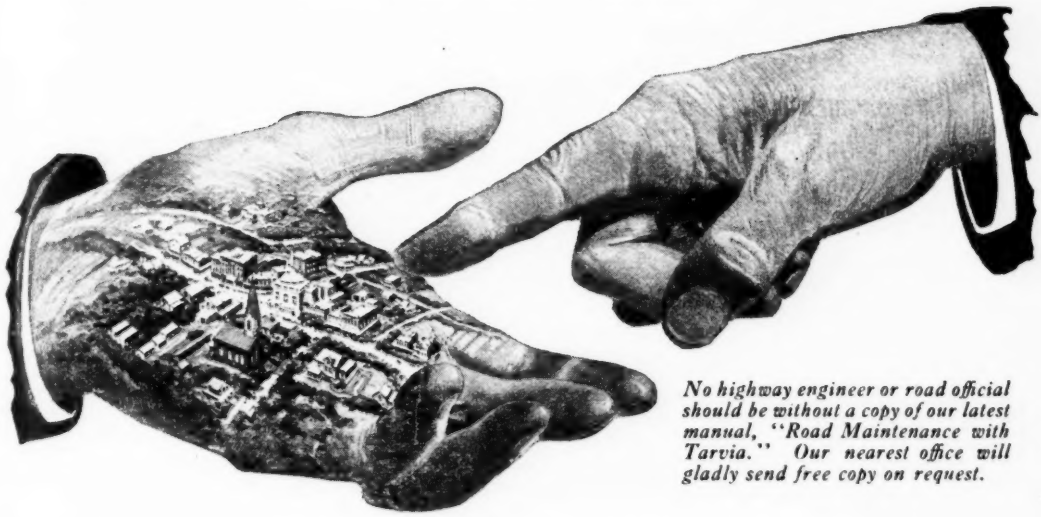
The oil may be applied by either the pressure or gravity feed system. We have adopted the latter on dirt roads on account of the excessive weight of the former, as we found that many of our small bridges and culverts would not carry the weight.

The oiling of hard surfaced roads, we believe, can be done much better by the use of the pressure system as it sprays the oil on much more evenly than can be done by gravity, but on dirt road this is not essential.

One theory of road maintenance is to keep the water out of the subgrade; that theory holds good here. Therefore, a sufficient amount of oil should be applied to form a cushion sufficient for use as a wearing surface, and to seal the surface of the road, thereby making it as nearly waterproof as possible, the exact amount to be applied can be ascertained only by the conditions found on the ground but for general purposes, we should say ½ gal. more or less, per sq. yd. of surface is necessary for the application of one coat. If more than one application is desired, a lighter oil, say one containing 40 to 50 per cent asphalt can be used first and when thoroughly set a second application of oil of 60 to 70 per cent asphaltum should be used; our experience has been that one coat in the spring and another one in the late fall produces the best results as it gives additional strength to the road for the hard and damaging traffic of the winter.

Thus, we believe, with a little care the foregoing procedure will produce a good and inexpensive road that will be smooth, dustless, noiseless and with sufficient rigidity to withstand a heavy rural traffic, the maintenance being very low compared to most hard-surfaced roads.

Missouri is about to enter into a road-building campaign through its newly appointed Commission which will present to each of the 114 counties new and perplexing problems in regard to roads. For a county adjoining or containing (as Jackson does) one of the large cities of the State, it must greatly multiply the number of its roads as they near the city to handle traffic which will naturally flow in from such a far-reaching and elaborate system as is projected by this State. Therefore, Jackson County, with her 250 to 300 miles of rock roads, from 16 to 18 ft. wide, will find herself confronted not only with the problem of building and maintenance of the higher type of roads,



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but the opening, construction and maintaining of many miles of new roads to accommodate the additional traffic; that will be in addition to approximately 750 miles or dirt roads now in use here, the upkeep of which brings us to the subject here—oiling roads.

In closing we wish to submit a copy of that portion of our yearly report pertaining to oiled roads which was submitted to the Jackson County Court on January 2, 1922.

*Road Oiling Department*

In the year 1921, there were 237 miles of dirt roads oiled once, 47.5 miles of dirt roads that were oiled twice, 151 miles of rock roads that were oiled once, and 21.5 miles of rock roads oiled twice, making a total mileage of roads oiled of 526. There were 1,679,306 gals. of road oil used at a cost of 6¼ cts. or $104,956.63. The cost of placing of the above given amount of oil was $43,113.70, or approximately 2½ cts. per gal.

There was an average of 3,200 gals. of oil used per mile, the cost of which was approximately $200 per mile, the application cost for which was approximately $81 per mile, making a total of $281 per mile. The total cost of road oiling was $148,070.33.

This paper by Mr. Koehler was presented at the annual convention of the Highway Engineers' Association of Missouri, held in Kansas City in January.

## ATLANTA ADOPTS ZONING

Atlanta adopted a zoning ordinance April 10, 1922, by a nearly unanimous vote of the Council. The ordinance divides the city into dwelling house, apartment house, business and industrial districts. Three classes of height districts are established with limits of 50 ft., 100 ft. and 150 ft., respectively. Building line, side yard and rear yard requirements are established for all buildings in the residence districts. Lot area requirements are based on the number of housekeeping units for which the residence building is arranged; 5,000 sq. ft. of lot area per family is required for much of the dwelling house area and 2,500 sq. ft. of lot area per family for the area suited to double or two-family house development. In most of the apartment house areas only 625 sq. ft. per family is required, while in the limited hotel and elevator apartment sections there is no minimum lot area requirement, though side, rear and front yards are required.

The zoning plan and ordinance was prepared for the Atlanta Plan Commission by Robert Whitten, City Planner, 4614 Prospect Ave., Cleveland, Ohio. The initial indifference or opposition of the public was overcome by an intensive educational campaign in which newspaper articles, editorials and cartoons played an important part. Five thousand copies of a tentative zoning map and of an attractive illustrated pamphlet describing the proposed zoning and giving the reasons why zoning is necessary, were distributed. Work on the zoning was started by Mr. Whitten in May, 1921, and the zoning ordinance became effective in April, 1922, a little less than a year from the time the work started. Atlanta maintains its reputation for progressiveness by being the first Southern city to adopt a comprehensive zoning plan.

## SELECTING TREES FOR CITY STREETS

Oaks are considered by the United States Department of Agriculture to be the best trees for street planting. It is probable that oaks have not been more widely planted because of the prevalent belief that they are slow growers, and because in the North they are rather difficult to transplant. A white oak, however, which is one of the slow-growing varieties, will reach the same height as a sugar maple in the same period of time, and maples have been used much more widely than oaks for street ornamentation, despite many unsatisfactory characteristics.

A new Farmers' Bulletin, No. 1208, "Trees for Town and City Streets," by F. L. Mulford, horticulturist, issued by the United States Department of Agriculture, describes in detail the various oaks for street use in different regions, as well as about 100 other trees or varieties. Elms are given second place in desirability for city streets, and sycamores third. Maples are considered less desirable than has been generally supposed. Except the Lombardy poplar, most varieties of poplar are not recommended.

The bulletin, which is available upon application to the United States Department of Agriculture, contains a regional map of the United States and indicates which trees flourish best under the climatic conditions of each region.

# WATER WORKS SECTION

## PUMPING PLANT OF NEW HIGH PRESSURE FIRE SYSTEM AT BUFFALO, NEW YORK

*By W. B. Powell, Treasurer, Industrial Planning Corporation, Consulting Engineers, 80 West Genesee St., Buffalo, N. Y.*

For a number of years past, the business district of the City of Buffalo has been protected by a high pressure system of water mains separate from the regular city supply, with special hydrants placed at important points throughout the district. This high pressure system is arranged so that the fire boats in the harbor can attach the discharge from their pumps to the ends of the mains at two points on the water front, thereby furnishing large volumes of water at about 140 lbs. pressure entirely independent of the supply provided from the pumping station.

*The Old High Pressure System.*

The mains for this service run north from the Buffalo River through Washington and Pearl streets to Huron, paralleling Main street on both sides and reaching within a block all of the high business and office buildings in the congested center of the city. Within this area is comprehended the largest building values and consequently it is also within these limits that the greatest street traffic congestion is to be found. Naturally the passage of the fire-fighting apparatus is considerably retarded through streets crowded with traffic and in addition the low pressure of the regular water system is inadequate to cope with a fire in the high office buildings in this district, so that the present high pressure system has been of great protective value.

Nevertheless, its use necessitates the stationing of one or two fireboats at fixed points, thereby withdrawing them from service as protectors of the harbor and water front property, and it has been recognized that this might prove a serious hazard in the event of a large conflagration. Furthermore, even at their best performance, the boats cannot adequately supply water for more than about 10 nozzles, so that the city authorities decided to extend and improve the high pressure system by installing a separate source of supply capable of much larger emergency service.

Fire Chief Murphy was principally responsible for this decision, and he has co-operated with Water Commissioner Andrews, under whose direction the plans have been developed and the work is now being installed. The design of the details of the pumping plant within the station has been done in detail by a firm of local engineers, the Industrial Planning Corporation, who have had a wide range of experience in special pumping problems.

*New High Pressure Main*

A new 20-in. cast-iron pipe main has been installed from the city pumping station at the foot of Porter Avenue through Jersey and Front Streets, to Georgia Street, where it is divided into two 16-in. mains, one branch continuing down Front Street through the Terrace to Pearl Street, where it joins the existing line in that street, and the other branch passing through Georgia and Huron Streets to Washington Street, connecting with the upper ends of both of the present lines in Pearl and Washington Streets. The old line in Washington Street was not adequate to carry the proposed 300 lbs. pressure of the new system and has been replaced with new pipe and a cross connection has been made at Exchange Street between the two principal mains so as to loop the entire system around the heart of the business district of the city.

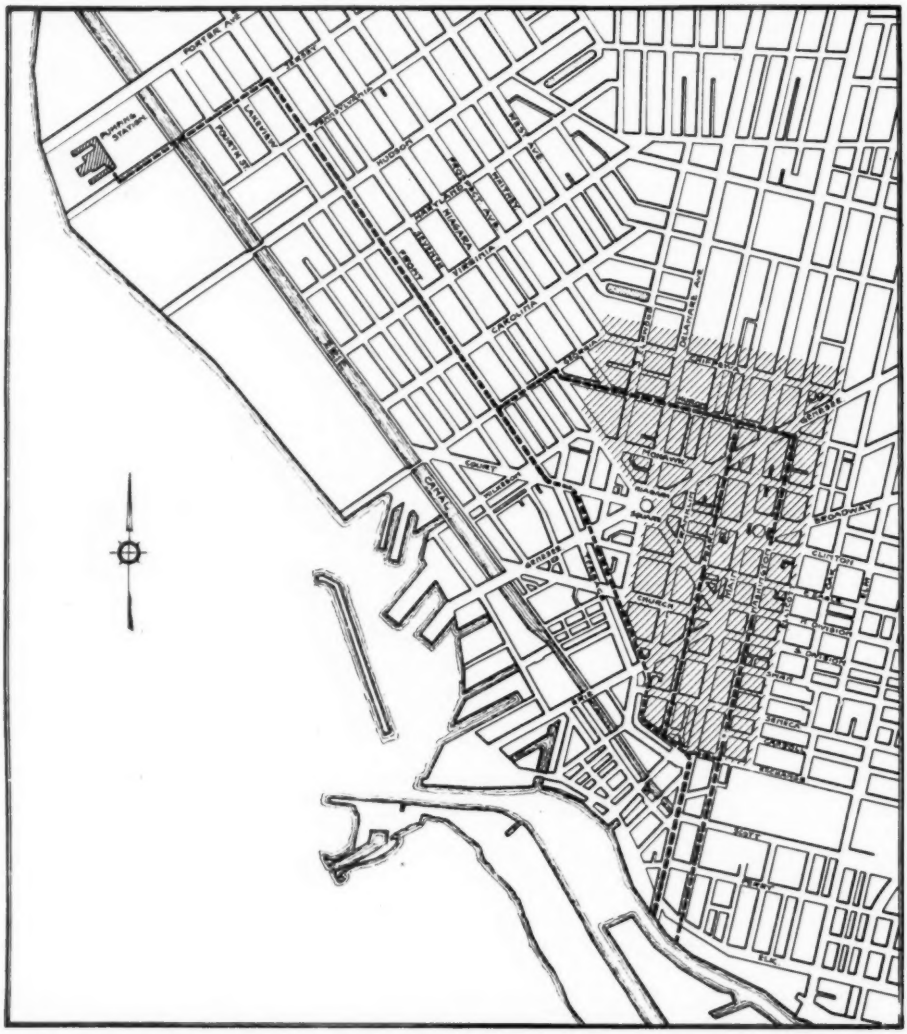
This district (shaded on map) may be said to be bounded roughly by the Terrace and Elmwood Avenue on the south and west, Chippewa Street on the north and Ellicott Street on the east, with the largest values centered along Main Street, so that this double loop system will provide adequate protective water supply from two directions to any point in the district, while it will also retain the present fireboat supply connections at the south end of the loop in the unlikely event of failure on the part of the new pumping station feeding the loop from the north. Incidentally, the future growth of the business section of the city is safeguarded because the trend of development is northward between Delaware Avenue

and Main Street, and still further the large area of industrial activity located along the water front and extending along the line of the old canal will now be protected from the land side by the main through Front Street and Terrace as well as by the fire boats in the harbor.

*The Pumping Plant*

The plant in the pumping station has been designed with the greatest care, having in mind above all other considerations instantaneous starting and dependability to deliver full capacity at all times, even though such service may be required only at very infrequent times. The present pumping station is already equipped with ample boiler plant so that no additional steam power is required, and consequently the question of economy of operation, important as it always is, was in this case considered as of secondary importance. The whole effort was centered on getting the full capacity of the plant into action at top pressure upon an instant's notice, and then to maintain its performance at that rate for an indefinite time delivering as large a volume of water as possible per pound of steam consumed.

The primary units of the plant will be three turbine-driven centrifugal pumps, each of 3000 gals. per min. capacity with a delivery pressure of 300 lbs. These pumps are designed so that they can




MAP SHOWING NEW HIGH PRESSURE FIRE SERVICE LINE FOR THE CITY OF BUFFALO, NEW YORK.

deliver their full capacity within 90 seconds after the sounding of the alarm at the station.

*The Steam Turbines*

The steam turbines are being furnished by the Terry Steam Turbine Company. They are rated at 750 H. P. each, using steam from the present station boilers at 225 lbs. pressure with 60 degs. superheat. They operate non-condensing, with a single rotor cut out of a solid block of metal and their normal speed is 3,170 R. P. M.

While every possible precaution is being taken to eliminate condensation in the steam lines, the necessity of being able to start up to full capacity instantly is so vital that the most rugged construction of rotor was selected, as well as a type of machine which is capable of passing a slug of water from the steam supply riser without any interruption or slowing of the apparatus.

The expense of condensing equipment was not considered to be justified for economy of operation in the face of the greater time required to start such apparatus and the greater complexity of mechanism which would tend to increase the hazard of a breakdown.

*The Pumps*

The pumps are made by the Manistee Iron Works and are 4-stage with solid bronze rotors running at 1,500 R. P. M. The speed reduction is accomplished by a set of herring-bone spur gears running in an oil bath, which forms part of a circulating and cooling oil system providing positive lubrication for all parts of the set. The manufacturers have joined in guaranteeing that the combined unit will deliver 8 gals. of water under the specified conditions for each pound of steam consumed.

A 30-in. suction main from the river, protected with a foot valve, furnishes supply to the 10-in. pump connections and the 10-in. delivery lines are brought into the 20-in. main header at an angle of 45 degs. so as to reduce line losses to a minimum. Any single pump or combination of pumps may be operated, and the entire system is kept full of water from the regular city supply at a pressure of about 40 lbs. so that immediately upon receiving an alarm it will only be necessary to open the steam throttle wide to bring a unit up to speed. Suitable check valves make the system automatic.

The construction work on the pipe lines in the down-town loop is already completed, and the installation of the pumping equipment will be accomplished during the coming summer.

*Acceptance Tests*

The specifications provide that full working tests shall be made before the equipment will be accepted, these tests to include the operation of each unit under full working conditions for a period of 24 hours, at least one of them for 48 hours, and the combined operation of all the units for total capacity for at least one hour. It is anticipated that most fires can be handled by only one pump, and that only the largest conflagrations will require the operation of all three pumps together.

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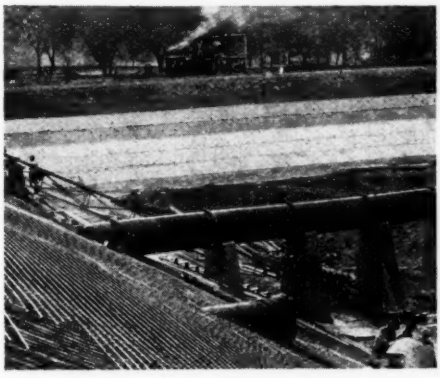
## FIFTH OMAHA RESERVOIR EMBODIES NEW PRINCIPLES IN DESIGN

The organization which operates Omaha's water plant has placed in operation the fifth of a series of water reservoirs built on a design which was untried, insofar as they knew, at the time the first was constructed nearly eight years ago. Fifty-nine million gallons of water are now stored in concrete lined basins of this design, and the condition of the first is such that the greatest confidence marks the inauguration into service of the fifth. A design embodying new principles, a constructing unit organized to build with painstaking attention to detail and the unswerving fidelity to the ideal of absolute perfection of each small unit of the aggregate, has produced a type of reservoir lining that, under the conditions imposed by the local topography and sub-



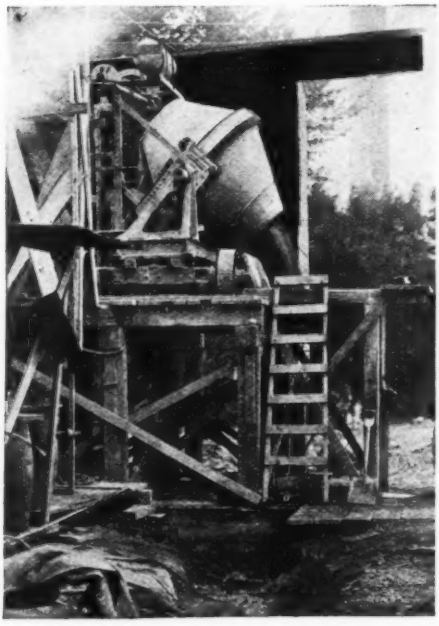
CONSTRUCTION VIEW OF THE FIFTH OMAHA WATER WORKS RESERVOIR.

soil formations, has met the desires of the designers.

*Lining Like Concrete "Blanket"*

The lining can best be described as a "concrete blanket," since it is not designed to be inflexible. The bearing soil is excellent, but it was expected that there would be local settlement, and a lining was constructed with a certain degree of flexibility to conform to these movements.

Six inches of re-inforced concrete is placed on the carefully compacted soil base in such a way as to get the nearest possible approach to a perfect bond between successive courses, the steel re-



VIEW OF THE 10-S SMITH TILTING MIXER USED ON CONSTRUCTION OF THE NEW WATER RESERVOIR AT OMAHA, NEB. A POWER LOADER AND EXTENDED TRACK MAKES IT POSSIBLE TO TAKE AGGREGATE FROM LOWER LEVEL TO THE HOPPER ABOVE.

inforcing is accurately spaced at the determined height above the bottom of the slab, and the aggregates are mixed in a plant designed to produce a product of as near uniform consistency and composition as is possible.

The aggregate used in Basin No. 7, constructed in the fall of 1921, consisted of a so-called Sand-Gravel, which might be quite as properly called a coarse sand, since a very small percentage is retained on a No. 4 sieve. The proportion was one part Portland Cement to three parts sand-gravel, and to this was added soap and alum as an integral waterproofing. The steel mat consisted of ½ in. square deformed bars spaced to give four-tenths of one percent of the area of the concrete, both transversely and longitudinally, and was rigidly tied and held so as to have its lower edge 1 in. above the bottom of the concrete.

*Concentric Courses*

Concrete was placed on concentric courses around the basin, the width of the course being limited by the height on the slope which could be placed without slipping. The edges of the previously poured course were roughened where necessary, all was treated with dilute hydrochloric acid and carefully washed. Finishing was done with wood floats and steel trowels.

The mixing plant was a permanent one, consisting of a No. 10-S Smith Tilting Mixer driven by electric motor, and the necessary receiving hopper and apparatus for mixing and applying the waterproofing. The mixer was placed on a frame at a sufficient height above the ground to allow two-wheeled buggies to be charged from the hopper and the elevating loading skip was served by one-horse dump carts. The Smith loader with extended track takes the aggregate from the lower level to the hopper above. A small boiler was necessary for dissolving the waterproofing soap and alum, and electrically driven pumps handled the prepared tempering water to the gaging tanks.

*200,000,000 Gal. Capacity*

All aggregates were carefully measured, including the sand-gravel, the cement, water and soap. The time of mixing was kept uniform and of sufficient amount, and every precaution taken to insure the highest possible quality of concrete.

Basin No. 7 is 303 ft. by 385 ft., and the depth from top of parapet to bottom of mud compartment is 36.5 ft. Its capacity is 20,000,000 gals., and will serve as a clear water basin in the present sedimentation system of purification, but is so located as to be used for the effluent from a filter plant. Mr. Knouse, engineer of the Water Board of Omaha, was in charge of this work.

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## REARRANGING THE PARK RIDGE, ILL., PUMPING STATION

*By W. T. McClenehan, Assistant Engineer with Pearse, Greeley & Hansen, 39 W. Adams St., Chicago, Ill*

Anyone at all familiar with the water works game knows that a pumping sta-

tion is always being remodeled, always changed. Pumps wear out; they become antiquated because of improvements in pump manufacture and they are supplemented by new and larger pumps added because of the city's increased population.

In spite of this constant change, men in charge of pumping stations frequently do not realize the value of a well-defined plan or program for making future additions to their pumping stations. They have adopted a "sufficient unto the day is the evil thereof" policy and improvements are made because of some immediate necessity forced suddenly upon them. As a result of this indifference many pumping stations have become a patchwork of machinery, pipe and buildings, often poorly related, one part to another, and sometimes curiosities wonderful to behold. The administration which adopts such a policy is not always to be blamed for its indifference for the men that make it up may be ignorant of the real engineering requirements. In such cases it becomes the duty of the engineer to make the administration see the real value of a well thought out plan for making additions.

In addition to adopting a plan for making improvements a city should occasionally take stock of the improvements it already possesses in the way of machinery, pipe, buildings, etc., to see whether they cannot be better arranged for pumping purposes. A study of this kind is especially advantageous where new equipment or new pumps are about to be added. The saving in friction and power may be considerable and the re-arrangement generally makes for a better looking, more convenient station.

The mayor and city council of Park Ridge, Ill., fully realized that their pumping station had been outgrown and that it needed remodeling. They therefore employed the firm of Pearse, Greeley & Hansen last December to study the future requirements of the city and to make plans for improvements needed in the pumping station.

Originally the pumping station consisted of a well drilled into the Pottsdam sandstone, an electrically driven deep-well pump and a 6-in. main laid in the pump room floor to a standpipe built just west of the pump house. Off this water main in the pump room floor were taken two 6-in. connections to the city, one leading south to a line in Center Street and one north to a line in Park Avenue. Valves were placed on these three lines, which were exposed in the pump room. No meter was included. It will be seen from this description that the arrangement of the original pumping station was not so bad at the time it was built. However, it was not long before changes were made which upset the arrangement. The standpipe was replaced by an elevated tank, involving two connections to the mains in the pump house and providing a new connection to the line in Center Street. A new well was drilled in a southwest room built under the sidewalk on Center Street and connections made thereto. A 12-in. line was laid from the Chicago water system at the city limits and three different connections were made to the Park Ridge mains inside the pump house and one outside. About this time the original well was abandoned. Recently an air lift system was partly installed in the newer well to supplement the water supply received from Chicago in hot weather when the demand in Park Ridge exceeded the amount of water the City of Chicago was willing to sell.

Two centrifugal pumps were bought and one temporarily installed to boost the pressure when the Chicago pressure is low. The intention was to arrange the pumps to take water from the well reservoir also but this work was never completed.

Such, therefore, was the situation about the plant when we took hold of it last December. There were no less than 11 different pipe connections to various mains inside the pump house and around the elevated tank. Most of the confusion was caused by the natural growth of the plant, but some of it was caused by incompleted construction. Even the pumper did not know where all the lines were. In fact, he scarcely knew the function of all the valves he had to handle.

Our first work was accurately to locate all valves, pipe lines, etc., inside and outside the building and to obtain the charactertistics of the pumps, motors and air compressors. From a study of the city's past increase in population and from a be about 6,000 and that the maximum 12-hour consumption would be about 1.5 mil- over a period of several months, we estimated that by 1935 the population would record of water purchases from Chicago lion gallons per 24 hours| For short periods during the 12 hours this rate would be exceeded but the tank we figured would supply the excess consumption. In addition it was estimated that the probable fire demand in 1935 would be about 3 million gallons per 24 hours.

The two centrifugal pumps had a com-

bined capacity of around 2 million gallons, so that it seemed likely that another pump would be required in the near future. Pipe lines were based on the requirements estimated for 1950 because of the greater life of the pipe. This rate was about 5 million gals. per 24 hours.

The problem of a layout was somewhat complicated by the awkward shape of the building, which was shaped like a flat-iron, with but few parallel or right-angle walls. The layout selected, places a 12-in. suction line along the south wall on the floor, connecting at one end to the Chicago main outside the building and extending into the well reservoir at the other end. Each end of this line will be valved for drawing water from either source of supply. Above the suction line will be placed the discharge header with a valved cross connection between it and the suction line. A Venturi meter is to be installed in the discharge line inside the pump house but leaving room for the cutting in of another pump when that pump becomes necessary. The water will be discharged toward the west toward the elevated tank, although the city is largely to the east of the pumps. The reason for this is that existing piping could be utilized to better advantage and that all water could be metered. Besides that, the largest flow at most times is likely to be into the tank.

Some re-arrangement of the outside piping was found necessary. The most important change is the addition of about 90 ft. of 8-in. pipe line to be laid to connect to an important point of intersection. A hydraulically operated valve was placed in a pit outside the pump house at the base of the elevated tank. The operating cock of this valve was placed inside the pump house on a post so as to be easily reached by the pumper in case of fire.

The pumps were so arranged that they would work either in parallel or in series, the change being accomplished by opening or closing one valve.

The switchboard is to be placed on a concrete platform at the level of the street above the pipe lines. The board was a part of a former purchase of pumps and motor equipment and is very good indeed. It has provision on it for no voltage and overload release and is made for push button and for automatic operation using a pressure gauge.

We have arranged to place the push button stations on the same post with the cock which operates the hydraulic valve.

The air lift system is being somewhat re-arranged and completed so that the well which has been fitted up with the well head can be used this summer. By this arrangement the engineer can do the following things without leaving the pump room:

1. Draw water from Chicago without pumping.
2. Draw water from Chicago using either or both pumps in parallel or in series.
3. Draw water from the well reservoirs, using either or both pumps in parallel or in series.
4. Operate the hydraulic valve.
5. Operate the air lift system.

Some old piping in the floor of the pump room can be utilized to discharge into the well reservoir whenever the older well is fitted up for use, which will be whenever the present supplies prove inadequate.

The only new machinery bought is a small vacuum pump to prime the centrifugals when it is necessary to pump from the reservoir.

The cost of the entire work is about $6,600, including the building and manhole construction. While this layout is not ideal in every respect, it shows what can be done to an existing pumping station at very small cost, utilizing existing equipment so as to make the whole station more serviceable, more workable and better looking.

The foregoing paper by Mr. McClenehan was presented at the recent meeting of the Illinois Section of the American Water Works Association.

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## WATER WORKS RECONSTRUCTION AT ROCKFORD, ILL.

*By Rodney C. Wilson, Superintendent of Water Department, Rockford, Ill.*

For a number of years Rockford has had an inadequate water supply. Sprinkling has been partially eleminated each summer and no effort made to get larger industrial consumers.

In 1910 the city had an investigation, of their water supply, made by Messrs. Mead, Maury and Alvord, their findings being summarized in a very complete and detailed report.

The only thing attempted, to follow out suggestions, has been the installation of two electrically driven unit wells, one in the north end and another in the south-

east end of town, also the laying of a few large mains.

In 1919 a bond issue was authorized and Messrs. Meade & Seastone, of Madison, Wis., retained as consulting engineers, to design and construct the new water works. The question of deep wells or filtered river water was decided in favor of deep wells; the opinion was that it would be foolish to purify water artificially, with an element of human error creeping in, when an abundant supply of pure water could be had by drilling, and at no greater expense.

The question of location was next decided and a location on the west side of the city chosen. The future growth of the city's population, and distribution system, was taken into consideration, as well as the cost of the land.

In designing the new plant the thought throughout has been to plan for the future and have adequate facilities for expanding and enlarging, and not repeat the mistake of former years, of having to relocate and practically abandon the present water works, because of the poor location chosen preventing any possible expansion. This is readily evident when one realizes that the old plant is on the bank of the Rock River, in the heart of the business district, and every pound of coal used has to be hauled by truck or wagons.

*New Concrete Reservoir*

The construction of the new plant was started in June, 1920, with the building of a 5,000,000-gal. reservoir, of reinforced concrete, and possessing several novel features of design. The floor and the walls of this reservoir are built as one unit and the columns and roof as another unit. One can readily realize that the expansion of the roof, with the sun beating down upon it, would be much greater than the walls, with the reservoir filled with water. This design eliminates the danger of the roof cracking the walls. To permit the movement of the roof on the walls, due to expansion and contraction, a greased, galvanized plate has been inserted on top of the walls.

*The Deep Wells*

As previously mentioned, the water supply is from deep wells. The drilling of the first well was started in July, 1920, and at the present time we have three wells completed, and the fourth one well under way. The wells, for the first 300 ft., are 14-in. bore and then, to the depth of 1,600 ft., are 12-in. diameter. The wells are cased with 15-in. steel pipe into the rock, to a depth of 110 ft. from the surface, at which point a cement joint is made. This effectively seals off the wells and prevents any ground water from seeping in. There are two underlying water supplies, one—St. Peters—which is at a depth of about 200 ft. and is about 150 ft. thick, the other the Potsdam sandstone, which is beneath the St. Peters and separated from it by the Magnesium limestone. This Magnesium limestone is about 250 ft. thick in this locality. Our wells thus extend into the Potsdam sandstone about 1,000 ft. The capacity of each well is estimated at between 2 and 2½ million gallons per day. These wells are separated from each other about a city block and it is believed that pumping at this rate the level of the water in the wells will not be drawn down over a maximum of about 80 ft. The water now stands in the wells about 30 ft. from the surface.

*The Pumping Station and Pumps*

The pumping station building itself is an imposing structure, set back from the street about 90 ft., built of Chicago common brick, with raked joints in chocolate-colored mortar, with a little standstone trim. The pump room itself is about 60 x 114 ft., rising 40 ft. above the foundation, this height being necessary to permit the installation of a 10 and a 15-ton Whiting crane. The right half of this building will contain a new 2,500 cu. ft. Laidlaw air compressor and a 1,500 cu. ft. Ingersoll-Rand air compressor. The latter compressor is now in operation at the old plant but will be moved some time this summer. This gives us a duplicate pumping outfit for the deep wells.

In pumping the wells an initial air pressure of about 100 lbs. is carried and the air conveyed through 6 and 8 in. Crane special coated pipe line to the wells. The wells themselves will be equipped with an Indiana air lift, which will force the water up and into a so-called booster chamber and from there into the reservoir, through a 16-in. conduit. The piping is so arranged that any one or all of the wells can be pumped at the same time.

The left half of the building will contain a 15,000,000-gal horizontal cross compound condensing Snow pump and a 10,000,000-gal. pump of similar make. The latter pump is now doing duty at the old pumping station.

The 36-in. discharge, from the reservoir, flows into a suction well, just outside of the pump room. This suction well is 24

ft. in diameter and has a valve chamber outside. The suction to the pumps is 30 ins. The pumps discharge into a 36-in. header connecting with the 24-in. discharge line. This header is arranged to feed the city in two directions and permits the by-pass of either pump. It is our aim to have a Venturi recording meter set in this line, to permit an accurate measurement of the send-out.

*The Boiler Room*

Adjoining the pump room is the boiler room, which is 62x75 ft., and has an extreme heighth of about 70 ft. This extreme heighth was made necessary by the installation of coal bunkers, which we expect to have installed by the middle of June. These are steel bunkers, suspended on steel columns, and have a capacity of 450 tons of coal; they are divided into four pockets, one of which is for ashes. The coal will be conveyed from the track, at the rear of the building, through a concrete tunnel, and fed to the bunkers by a link-belt. The boiler equipment consists of three 300 H. P. Stirling boilers, equipped with the Jones underfeed automatic Stokers. The boiler feed water is softened by a Graver Corporation water softener, which uses lime and soda ash. The filtered water from this softener goes to a Reliance, open type, feed water heater and from there it is pumped into the boilers.

The plant is designed for efficient operation. The automatic stokers, the overhead bunkers and automatic scales and ash conveyors cut the labor charges in the boiler room to a minimum. The condensing engines, feed water heaters and steam traps, for turning all condensation into the hot well, permits the efficient operation from the steam consumption standpoint.

When completed the cost will be approximately $750,000, which added to the previous investment of the city, in water works and distribution system, makes a total investment for the city of about $2,000,000. This is about $20 per capita, and is, I believe, slightly under the average for cities throughout the United States.

We expect to have the plant tested out in May and it should be pumping and supplying the city with water this summer.

The foregoing paper by Mr. Wilson was presented at the recent annual meeting of the Illinois Section of the American Water Works Association.

# GROUND WATER SUPPLIES FROM PRE-GLACIAL VALLEYS

*By Willis D. P. Warren, of Holbrook, Warren & Andrew, Consulting and Designing Engineers, Millikin, Bldg., Decatur, Ill.*

*General*

Ground-water supplies are generally found in pre-glacial valleys and it is therefore, of considerable importance to understand the methods of determining the location and boundaries of such valleys. It is the purpose of this article to discuss and emphasize the principles which govern the economical development of shallow ground-water supplies and to point out the relation which deposits furnishing such supplies have to the pre-glacial valleys.

In Illinois, where there are more than 600 cities and villages of less than 2,000 population without a public water supply, and where many of the other cities are in need of additional supplies, it is a matter of the most vital importance that we utilize all the resources which have been so generously provided by nature, and it is with this thought in mind that it is proposed to show the value of water-bearing deposits in the pre-glacial valleys, and the methods of developing same.

*Experience of Virden and Girard, Illinois*

During the past 5 years ,and to a certain extent during the past 30 years, the cities of Virden and Girard, located in Central Illinois, have endeavored to develop water from wells, and as the experience of these cities is somewhat typical, it may be of interest to point out the ease with which they finally discovered a water supply in a pre-glacial valley, after many years of tests and experiments elsewhere.

*Preliminary Investigations Virden and Girard:*

Virden has a population of about 5,000, and Girard about 2,500, and as each had spent considerable money at various times in seeking a water supply from wells, it was finally decided last year that our firm should be employed to make surveys and estimates of reservoir sites with a view to the development of a surface supply, suitable for both towns, inasmuch as they are only 2½ miles apart.

At that time Virden had abandoned all hope of a supply from wells and Girard was testing a territory which had shown but slight promise of a well supply during former investigations .

Upon completion of preliminary surveys, plans and estimates of surface sup-

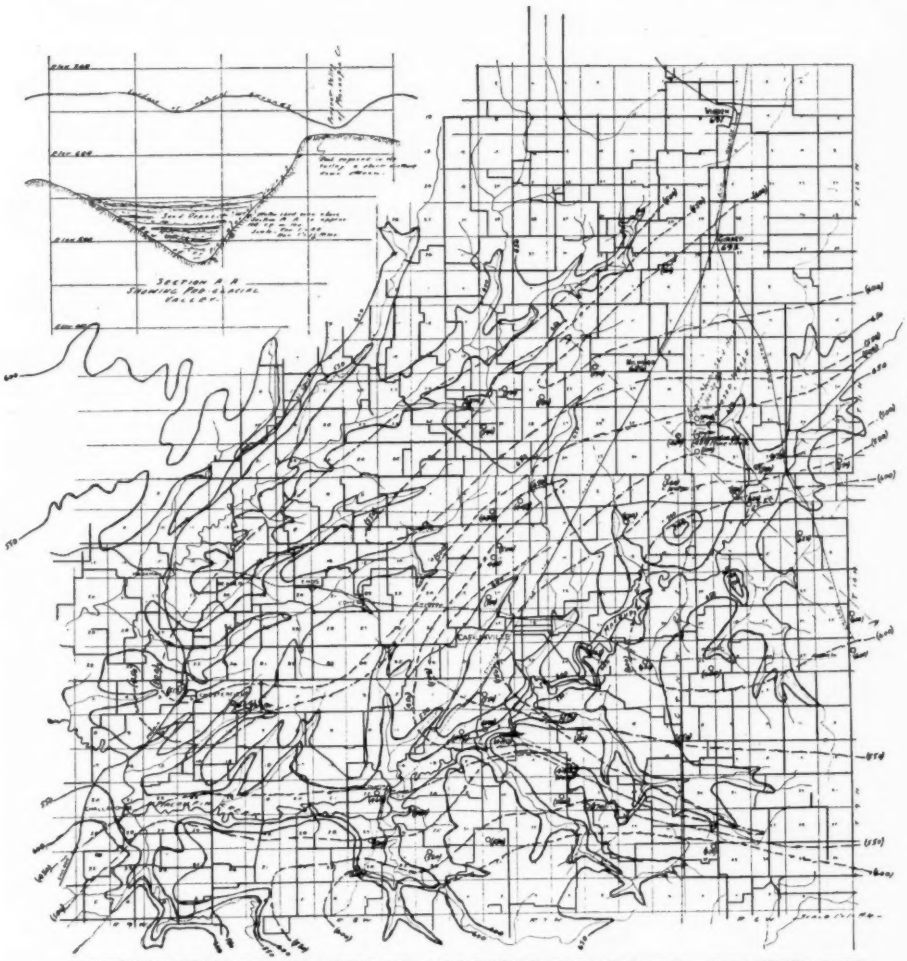
plies, it was seen that unusual costs would be involved due to the lack of a natural reservoir site, and therefore further consideration was again given the possibility of a well supply, even though it might be located at some distance from the city.

As Virden had put down 12 to 15 holes, the majority of them on one 40-acre tract, and had failed to secure a well supply, and as Girard had more recently put down 10 or 12 holes, also with poor results, it was finally decided that consideration would be given a location about five miles south of Girard and nine miles south of Virden, early information regarding this site tending to show a remarkable supply of ground-water available. Accordingly the investigation of a well supply was undertaken in this territory, the final result being the discovery of a pre-glacial valley filled with water-bearing sand and gravel, and fed from a water shed area of approximately 100 sq. miles.

*Locating the Pre-Glacial Valley*

There are several fundamental principles involved in the development of shallow ground-water supplies, and one of the most important of these was clearly stated by Hubbard and Kiersted in "Water Works Management and Maintenance," as follows: "No more water can be continuously taken out of the ground than goes into it." In other words, the extent of the water shed area which feeds the underground gravel bed is of vital importance.

With this principle in mind we had



OUTLINE MAP OF PORTION OF MACOUPIN COUNTY, ILL., SHOWING SURFACE STREAMS, SURFACE CONTOURS WITH 50 FT. INTERVALS AND SUBSURFACE CONTOURS ON BOTTOM OF GLACIAL DRIFT WITH 50 FT. INTERVALS.

Surface Contours in Solid Lines. Subsurface Contours in Dotted Lines. Circles Indicate Points at Which Borings Were Made to Investigate Subsurface Conditions.

some difficulty in becoming interested in the development of wells at the site suggested, for a glimpse at the map showed only a few square miles of water-shed area, with a prospect therefore of being able to develope a very limited supply.

As the reports of water found were quite positive, however, a conference was held with officials of the Standard Oil Company at Carlinville, Illinois, and substantially the following information secured:

Mr. C. W. Clark, Assistant General Manager, stated that a year or so previously his company had undertaken to put down a modern mine shaft there ,that after going down some distance they encountered unusual quantities of sand and water, and that finally after having pumped for days, and after having spent approximately $200,000 they were absolutely forced to abandon the shaft due to the strong flow of water. Pumping did not lower the level of water over a few feet below the ground surface.

As this shaft was located in a rather flat prairie country it was difficult to account for such a flow. However, as Mr. Clark kindly offered his files showing record of drill holes in that territory ,it was possible to trace the source. In fact the information secured from these files, together with additional records of drillings from the State Geological Survey afforded an opportunity to study the relation of the ground-water to the pre-glacial valley which ordinarily could not have been done except by sinking a number of carefully located test wells.

*Sub-Surface Contours*

The accompanying plan shows a general outline map of this territory, with streams, surface contours at 50-ft. intervals, and sub-surface contours, or contours on the bottom of the glacial drift, at 50-ft. intervals.

These were located by platting the elevation of the base of the glacial drift as determined by test holes, and the final result shows the pre-glacial valley of Macoupin Creek located north of Carlinville, underlying a flat prairie country, while the modern valley of Macoupin Creek is south of Carlinville, as is clearly shown by the cross-section, and is located at an elevation practically 140 ft. higher than the pre-glacial valley, thus tending to cause the undergroind waters of Macoupin Creek to seek the pre-glacial valley.

It appears from a study of the situation presented here, that the glacier in flowing to the south covered over the old valley, and since then the modern creek has gradually cut its way to rock or shale at points south of Carlinville. The presence of unusual amounts of water in the pre-glacial valley to the west of Carlinville was noted by drillers, although all the holes shown were put down in a search for oil .

In the interpretation of the drill records and other data bearing on this development, much credit is due Mr. G. C. Habermeyer of the State Water Survey and Dr. M. M. Leighton, of the State Geological Survey, both of Urbana.

In this connection, Mr. Habermeyer advised in part as follows: "Report of water supply investigations for Virden and Girard, dated February, 1922, is received and read with interest. That looks like an excellent job in tracing out old stream valleys."

Also under date of March 15th, Dr. Leighton advised as follows: "I have gone over the evidence bearing on the question of an old pre-glacial valley in the vicinity south of (Girard) Nilwood. This evidence seems to be good and the existence of sand and gravel at the bottom of this valley, as tested by several wells, and the abundant supply which came from the shaft of the Standard Oil Company, all indicate that this is a favorable place to drill for a water supply."

*Advantages of Gathering Ground*

In considering the vicinity of the Standard Oil shaft as a location for the development of a ground-water supply the following important facts and advantages should be clearly understood:

1. The percolating water that fills the sand and gravel deposit in the old pre-glacial valley, is supplied from a water-shed area of 100 square miles, an area sufficient to provide for a population of several hundred thousand.

2. Storage of the percolating water depends on the extent of the sand and gravel deposit in the pre-glacial valley, and in this case sufficient test holes have been put down to indicate ample storage.

Probably one-fourth to one-third the volume of sand can be taken as the volume of water available, and from the data shown on accompanying plat it is readily seen that the supply of water here is more than adequate. At some points the sand shows a depth of 100 ft.

3. The longitudinal and transverse slope of the pre-glacial valley is such that maximum velocity of flow of water will be secured, in so far as the quality of sand will allow.

4. The quality of sand is such as to permit the development of water at reasonable cost. In most deposits of this character, the sand varies in coarseness at different points in the valley, and the final location of wells and the type of screens and installation will depend somewhat on the quality of sand available. In the present case the sand is of a quality to permit development of wells at a reasonable cost.

*Importance of Studies*

In the studies and investigations made over an extended period of years in the vicinity of Virden and Girard by various city councils under different engineers, it may be seen that little thought was paid to the importance of locating the pre-glacial valley. Had a series of holes been put down west of Girard or north of Virden, determining the location of the pre-glacial valley and the water-shed area, much useless expense and delay might have been avoided.

As the situation stands today, there has been so much haphazard drilling through this territory that the people have little heart in any suggestion as to a more careful study near Girard or Virden and, therefore, considering the positive information which we have regarding the supply near the Standard Oil shaft, it is thought that no further expense should be incurred in prespecting elsewhere .

A study of old pre-glacial valleys has shown that the present channels are often quite remote from the old, and this is fully borne out by the situation south of Girard.

A glance at the map will indicate the value of knowledge relative to the pre-glacial valley north of Carlinville, as that city may at some future date require an additional supply of water.

It is desired to point out here that a complete mineral analysis is of course essential before final adoption of any site. However, the point to be made in this discussion is the relation of the pre-glacial valley to well supplies, rather than a comparison of mineral qualities of underground and surface supplies.

The cities of Virden and Girard have not yet proceeded to the construction of a pumping plant at the site of the Standard Oil shaft, but they have secured positive information as to the existence of a remarkable water bearing deposit in their vicinity, information which they have sought for many years, and as a result, they are a step nearer the final solution of their water supply problem.

*Comparison With Surface Requirements*

It is quite generally understood that in developing a surface supply certain fundamental principles govern, and it is desired again to point out here that certain fundamental principles also govern in the development of a shallow ground-water supply.

Briefly the considerations which govern the development of impounding reservoirs are as follows: 1. Extent of water-shed area. 2. Rainfall. 3. Run-off. 4. Percolation. 5. Storage available.

For the development of a shallow ground-water supply, the fundamental principles which govern are as follows: 1. Extent of water-shed area. 2. Rainfall. 3. Run-off. 4. Percolation: 5. Storage available.

Comparison shows that the fundamental requirements are absolutely the same. And yet how few cities know and apply these principles? How many cities having wells know the area of the water-shed from which they are supplied, and how many have knowledge of the available underground storage?

Hubbard and Kiersted, above referred to, point out the following fundamental considerations which govern:

"No more water can be continuously taken out of the ground than goes into it.

"The yield of the ground-water is dependent upon the character and extent of the catchment area and depth of the saturated water-bearing material.

"The velocity of flow of ground-water depends upon the character of material through which it must pass in gravitating from a higher to a lower level.

"The stability of the ground-water supply depends upon the three considerations above stated as well as upon available ground storage at the point selected for developing the water supply."

Goodell, in his book "Water Works for Small Cities and Towns," also states this principle, as follows:

"The amount of water that may be obtained from deep and shallow wells is so often over-estimated that it is necessary to call attention to the fact that the quantity available depends on the *same* conditions as the amount of surface water, that is, the extent of the catchment area, the rainfall, the proportion of the rainfall entering the ground and the capacity of the basin to hold ground-water."

It may be contended that it is a rather

difficult and expensive matter to determine the water-shed area and the amount of underground storage. Possibly this is true, and yet does not the cost of a water works system require certain expense for investigation, and does not the planning of a works capable of fitting into any future scheme of development require very thorough and careful study? In the development of a surface supply we do not accept a natural reservoir site without knowledge of the water-shed area and the other factors which govern, and as indicated by the above authorities, exactly the same principles should apply in the development of ground-water.

Again we must distinguish between the well supply developed from pre-glacial valleys and from sand and gravel deposits elsewhere in the drift. Such deposits in the drift are sometimes more difficult to define as to location and extent, and generally are more limited in volume, and for this very reason they are more liable to failure unless thoroughly explored.

With these principles in mind it appears that the value of pumping tests, especially those limited to a few weeks or months, have been over-estimated. Pumping tests, except to secure samples of water are as a rule very deceptive and unnecessary.

*Conclusion*

The investigation of a new or of an additional water supply should be conducted along broad lines, keeping constantly in mind that such investigations may be properly extended a distance of 5, 10, 20 or even more miles beyond the city limits. A few comparisons in cost may show that a well supply can be developed at distances not heretofore seriously thought of. The present lower cost of cast iron pipe and the high cost of reservoir lands, are factors which will influence a final decision.

Keeping clearly in mind the fundamental principles which govern the development of a shallow ground-water supply, and realizing the relation thereto of deposits in the pre-glacial valley, it will be of interest to consider proper methods of development. These may be briefly summarized as follows:

1. An examination of the extent of all possible water-shed areas within reasonable distance. As a very rough rule, we might say that a city of 2,000 population can economically develop a well supply at a distance of not over five miles, while a city of 50,000 might economically develop a well supply at a distance of not over 15 or 20 miles, depending on availability of natural reservoir sites, relative elevations, cost of land, etc. The advantages of a well supply, with low first cost and low operating cost, will justify extending our investigations over a wider field than generally considered necessary.

2. An examination of well records, test holes, borings and other data in the territory under consideration. Such records can often be secured from coal, oil or gas companies, local well drillers, and of most importance in Illinois, through the State Geological Survey at Urbana. Some such records are confidential; but the portion relating to depth of glacial drift is not, and can generally be secured to be used in the investigation of a municipal supply.

3. A thorough study of all available records with a view to determining the dip of the rock or shale at base of glacial drift and the location of pre-glacial valley. This study should be made before the location of any additional drill holes is considered. Often the elevations as disclosed by the records of two or three old holes will indicate the direction of the pre-glacial valley, and a little further investigation should definitely establish its boundaries.

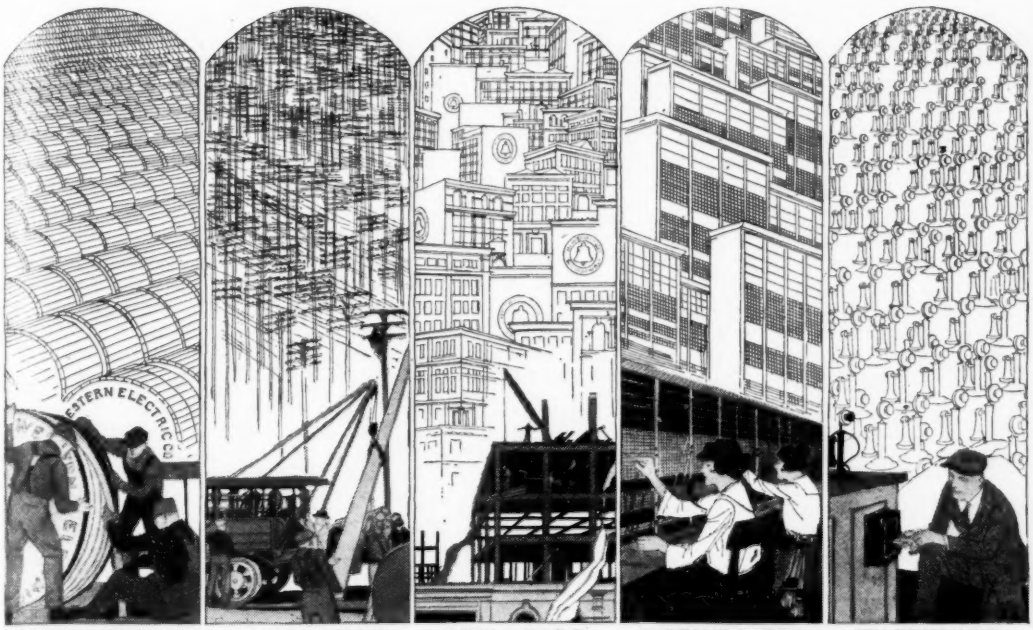
4. The application of knowledge obtained through these studies and the location of test holes in accordance therewith. Such test holes should furnish sufficient additional data to determine the possibilities of any site under consideration.

5. With complete and accurate data as to the fundamental principles which govern, a conclusion can then be reached as to the value of such a supply, compared with a surface supply, and recommendations made regarding future developments with a full knowledge that all facts relating thereto have been properly considered and analyzed.

In this connection it is interesting to recall the definition of Engineering: "Engineering is the art of directing the great sources of power in nature for the use and convenience of man."

In the deevlopment of ground-water supplies from pre-glacial valleys we may feel a certain professional pride in the fact that we are directing the great sources of power in nature for the use and convenience of man.

In final conclusion it is desired to point out that nature in her wonderful plan, provided many resources for our comfort and convenience, coal, iron, gas, oil, the precious metals, and most valuable of all, water. This water, filtered and stored for

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1,875,000 miles of wire, enclosed in 1,500 miles of cable, were added to underground and submarine lines in 1921. New underground duct totaling 11,000,000 feet was constructed, this representing approximately 300 miles of subway. 69 new central office buildings and important additions were completed or in progress, and new switchboards with a capacity of many thousands of connections were installed.

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our use as required, is hidden away in the great sand and gravel deposits of the preglacial valleys.

Its value lies in its economical development, and this can be accomplished only by a knowledge and application of the fundamental principles which govern.

The foregoing paper by Mr. Warren was presented before the recent annual convention of the Illinois Section of the American Water Works Association.

## NEW NON-FREEZING STRAIGHT DYNAMITE SUCCESSFULLY USED IN DITCHING

A ditch blasting test in snow and ice of the new non-freezing straight dynamite manufactured by the DuPont Company was made during the last few days of November, 1921, near Wausaukee, Wisconsin. The ditch was blasted by the propagated method and the dynamite was loaded through 8 ins. of snow and about ½ in. of ice in wet soil, the temperature of which was 35 deg. F. at the point of the load. Moreover the dynamite used had been exposed in storage to freezing temperatures for several weeks. The results were absolutely perfect in every respect.

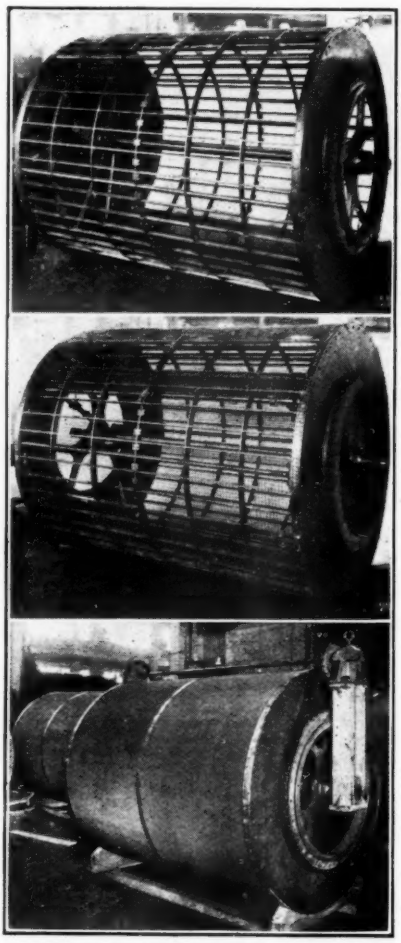
The test is regarded as of great importance to farmers and other users of dynamite for open work during the winter months. Straight dynamite has for years been the standard of the world in nearly every kind of open work, but a disadvantage has been its liability to freeze at temperatures below 50 deg. F. Any dynamite loses some part, if not all, of its efficiency when chilled or frozen and many attempts have been made to make the explosive low-freezing. The test reported of the ditch blasting in snow and ice in Wisconsin shows that thawing with its loss of time and attendant danger has practically been eliminated.

## SEWAGE SCREENS FOR INDIANAPOLIS, INDIANA

Sewage screens of the type being installed by the Sanitary District of Indianapolis are shown in the accompanying views.

The screens, of which there are 13, are set in individual wells containing sewage-laden water to a depth of approximately 2 ft. As the screens revolve, the liquid passes through the screen cloth to the interior of the drum and is discharged through the drum head to a trough leading to the settling tank. Meanwhile the solids are removed from the tank by means of scraper conveyors.

The screens, manufactured by the Chain Belt Company, Milwaukee, are each 6 ft. in diameter and 7 ft. 6 ins. long. They are made almost entirely from bronze to prevent corrosion. The frame-work is similar to a squirrel-cage, and around this are wrapped two courses of screening, the inner one a very open mesh, while the outer one is fine enough to prevent practically any of the solids from entering the drum.



VIEWS OF THE TYPE OF SEWAGE SCREEN BEING INSTALLED BY THE SANITARY DISTRICT OF INDIANAPOLIS.

The screens are mounted on a through shaft in bronze bearings. They are driven by Rex Chabelco steel roller chain operating over Temperin sprockets.

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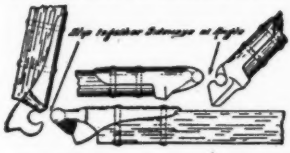

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—Curb Boxes
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—Derricks, Pipe Laying
—Derricks, Steel Portable
—Drinking Fountains
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—Engines, High Duty
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—Gauges, Water
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—Pumps, Boiler Feed
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—Pumps, Deep Well
—Pumps, Steam
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# Construction News and Equipment

## FACTS AND FIGURES INDICATE THAT NOW IS THE TIME TO INSTALL PUBLIC IMPROVEMENTS

Since last September, there has been a decided drop in the cost of all materials entering into municipal construction work, in fact, all building materials as well. The municipal contractor has been standing outside anxiously awaiting an opportunity to resume his occupation and at the present time his keenness for work has somewhat subdued his good judgment, for never in the history of municipal work have prices been cheaper where work has been let. At our lettings, we have had from 20 to 40 contractors bidding on the work and each one has vied with his neighbor and practically bet that they could complete certain work at a profit, although, to the engineers, the work was let for so cheap a price that the contractors have seemed to face a loss from the start.

While the present conditions are bad for the municipal contractor, they are a great aid to the municipalities of the country provided the cities see fit to take advantage of these unusual conditions. At the present time, all municipal improvements are going in on a buyer's market, as has been ascertained by lettings held within the past two months. If the municipal officers of cities and villages throughout the country could realize the savings to be made through letting work at this time they would make an earnest effort and take immediate steps for the installation of such necessary improvements as may have been held in abeyance or may become necessary at this time.

These have to do with water works, sewers, electric light plants, pavements, curb and gutter, city parking, etc. These improvements, in many instances, have been put off during the war and since, to the detriment of the municipality.

These may be installed now at minimum cost to the taxpayer, whose payments may be spread in usual cases over a period of from 10 to 20 years to finance the improvements. There are many other advantages to be had at the present time, besides the low cost of the work. It is true that about 25 percent of the cost of any municipal work remains in the city or village in which the work is done. This is due to the employment of local labor by the contractor, repairs to equipment and machinery, purchase of fuels, oils, lumber, cement and other commodities, as well as the board and room and other incidental purchases made by any foreign labor. The spending of this money in itself means a considerable asset to the municipality. The progress of the improvement itself means another splendid advantage. The advertising the municipality secures through doing the work also helps out. In many instances, the contractor simply "swaps" his dollars for the work so accomplished because of the extremely low prices he has to make to secure the work in competition with others.

*Some Present Day Low Prices*

When a municipality can obtain an 8 in. vitrified tile sewer 7 ft. deep, for 70 cts. a foot, 9 ft. deep for 80 cts. a foot and 11 ft. deep for 90 cts. a foot and 13 ft. deep for $1, with other prices of other sizes and depths of pipe in proportion; and water main at the following prices: 4-in. cast-iron, Class B, bell and spigot water main at 85 cts, 6-in. at $1.17 and 8-in. at $1.63, with other prices for valves and hydrants and fittings in proportion, it is certainly an advantageous time to let work. A 6-in. concrete pavement has been let as low as $2 per sq. yd., curb for 45 cts. to 70 cts. and sidewalks 11 to 15 cts. per sq. ft. Brick pavements were let including grading, curb and gutter and all other items, including engineering, at $4.62 per sq. yd. on a 6-in. concrete base with asphaltic filler. Warren Butulithic pavements per square yard have been let as cheap as $3.10, woodblock pavement with 3½-in. blocks, 16 lbs. penetration, has been let for $5.06, including concrete base, curb and excavation. Steel water towers and tanks have been going at greatly reduced prices, and while concrete towers and tanks can not be built as cheaply, their price has also been greatly reduced. A 150,000-gal. steel tank

on a 75-ft. tower of steel was recently let for $8,389 at De Smet, South Dakota. The cost of sewage disposal plants of the Imhoff type have been greatly reduced, as has also been the cost of building of pump houses, the furnishing of pumping equipment and the building of open wells.

### *Prices at Typical Letting at De Smet, South Dakota*

A typical letting was held at De Smet, South Dakota, on April 27th, and so the readers of this article may have a comprehensive idea of such reduction in prices as has occurred, we are giving a resume of the bid of the successful contractor in Tables I and II. The remarkable thing about this letting was that the successful man was the low bidder by only $2,000. It should be noted that the water works system will be laid under splendid conditions in very wide streets. The sewer, however, will be laid under somewhat adverse conditions, being mainly located in 16-ft. alleys. Following is a tabulation of the prices of the low bidder and the engineer's estimate of cost.

In the tables the reader will see the itemized total prices bid as well as the itemized prices in the engineer's estimate, and he will conclude that the contractor stripped himself to the bare bone and that as the plans and specifications are rigid and must be followed in their entirety, the contractor is practically "swapping" dollars. If it were not for the sewers being installed in the alleys, he might be able to make a fair profit. The only advantage to a contractor must, therefore, be through having given his organization work. Such prices throw a considerable burden upon the consulting engineers in charge of the work, because, when a contractor is making a fair profit he is more willing to carry out the details of the construction work than he is on a losing proposition.

So that this contractor may complete his work in the shortest possible time, he is placed under penalty of $1,000 per month, which $1,000 per month is deducted from the amount of the contract from start to completion of the work. All water mains, hydrants, valves, fittings, etc., are inspected at the foundries and all material used throughout the construction must be first class in every respect. The cement entering into the construction of the disposal works, well and pump house, is all tested in accord-

TABLE I—COMPARISON OF CONTRACT PRICES WITH ENGINEER'S ESTIMATE ON COMPLETE SEWER SYSTEM AT DE SMET, SO. DAK.

| Quantity. | Item. | Contract Price. Unit | Contract Price. Total. | Engineer's Estimate. Price. Unit | Engineer's Estimate. Total. |
|---|---|---|---|---|---|
| 1,400 ft. | 8 in. vit. tile sewer 5-7 ft. deep... | $ .70 | $ 980.00 | $ 1.00 | $1,400.00 |
| 7,500 ft. | 8 in. vit. tile sewer 7-9 ft. deep... | .75 | 5,625.00 | 1.15 | 8,625.00 |
| 5,200 ft. | 8 in. vit. tile sewer 9-11 ft. deep... | .85 | 4,420.00 | 1.40 | 7,280.00 |
| 2,400 ft. | 8 in. vit. tile sewer 11-13 ft. deep... | 1.00 | 2,400.00 | 1.80 | 4,320.00 |
| 500 ft. | 8 in. vit. tile sewer 13-15 ft. deep... | 1.37 | 685.00 | 2.50 | 1,250.00 |
| 300 ft. | 8 in. vit. tile sewer 15-17 ft. deep... | 1.40 | 420.00 | 3.40 | 1,020.00 |
| 500 ft. | 10 in. vit. tile sewer 5-7 ft. deep... | .80 | 400.00 | 1.20 | 600.00 |
| 600 ft. | 10 in. vit. tile sewer 7-9 ft. deep... | 1.00 | 600.00 | 1.40 | 840.00 |
| 500 ft. | 10 in. vit. tile sewer 9-11 ft. deep... | 1.15 | 575.00 | 1.60 | 800.00 |
| 400 ft. | 10 in. vit. tile sewer 11-13 ft. deep... | 1.40 | 560.00 | 2.00 | 800.00 |
| 100 ft. | 10 in. vit. tile sewer 13-15 ft. deep... | 1.60 | 160.00 | 3.00 | 300.00 |
| 200 ft. | 10 in. vit. tile sewer 15-17 ft. deep... | 2.60 | 520.00 | 3.70 | 740.00 |
| 500 ft. | 12 in. vit. tile sewer 5-7 ft. deep... | .90 | 450.00 | 1.60 | 800.00 |
| 30 ft. | 12 in. vit. tile sewer 7-9 ft. deep... | 1.00 | 30.00 | 1.80 | 54.00 |
| 400 ft. | 12 in. vit. tile sewer 9-11 ft. deep... | 1.20 | 480.00 | 2.20 | 880.00 |
| 1,000 ft. | 12 in. vit. tile sewer 11-13 ft. deep... | 1.45 | 1,450.00 | 2.80 | 2,800.00 |
| 150 ft. | 12 in. vit. tile sewer 13-15 ft. deep... | 1.70 | 255.00 | 3.25 | 489.00 |
| 700 ft. | 15 in. vit. tile sewer 5-7 ft. deep... | 1.50 | 1,050.00 | 1.85 | 1,295.00 |
| 300 ft. | 15 in. vit. tile sewer 7-9 ft. deep... | 1.65 | 495.00 | 2.00 | 600.00 |
| 300 ft. | 15 in. vit. tile sewer 9-11 ft. deep... | 1.94 | 582.00 | 2.40 | 720.00 |
| 200 ft. | 15 in. vit. tile sewer 11-13 ft. deep... | 2.24 | 448.00 | 2.90 | 580.00 |
| 200 ft. | 6 in. house chimneys | 1.50 | 300.00 | .50 | 100.00 |
| 560 | 8x6 in. Y branches | 1.70 | 952.00 | 1.50 | 840.00 |
| 75 | 10x6 in. Y branches | 2.40 | 180.00 | 2.00 | 150.00 |
| 65 | 12x6 in. Y branches | 3.00 | 195.00 | 3.00 | 195.00 |
| 30 | 15x6 in. Y branches | 4.00 | 120.00 | 4.00 | 120.00 |
| 58 | Manholes | 75.00 | 4,350.00 | 75.00 | 4,350.00 |
| 4 | Lampholes | 20.00 | 80.00 | 20.00 | 80.00 |
| 20 | Cu. yds. rock excavation | 3.00 | 60.00 | 7.00 | 140.00 |
| 10,000 | ft. B. M. sewed lumber per M. B. M. | 20.00 | 200.00 | 40.00 | 400.00 |
| 15,000 | sq. ft. sheeting and bracing, per M. sq. ft. | 25.00 | 375.00 | 50.00 | 750.00 |
| 10 | cu. yds. 1:2½:5 concrete | 12.00 | 120.00 | 12.00 | 120.00 |
| | Total | | $29,517.00 | | $43,436.50 |
| 1 | Imhoff tank complete | ..... | 5,468.00 | ..... | 6,000.00 |
| | Sludge bed and by-pass | ..... | 1,050.00 | ..... | 1,200.00 |
| 1,000 | 15 in. drain tile 3-5 ft. deep | .90 | 900.00 | .75 | 750.00 |
| 350 | 15 in. drain tile 5-7 ft. deep | .90 | 315.00 | 1.00 | 350.00 |
| 10 | cu. yds. concrete 1:2½:5 | 15.00 | 150.00 | 12.00 | 120.00 |
| | Total | | $37,400.00 | | $51,856.50 |

TABLE II—COMPARISON OF CONTRACT PRICES WITH ENGINEER'S ESTIMATE ON COMPLETE WATER WORKS SYSTEM AT DE SMET, SO. DAK.

| Quantity. | Item | Contract Price— Price. Unit | Contract Price— Total. | Engineer's Estimate— Price. Unit | Engineer's Estimate— Total. |
|---|---|---|---|---|---|
| 16,500 ft. | 6 in. C. I. pipe complete, 7 ft. trench. | $1.17 | $19,305.00 | $1.30 | $21,450.00 |
| 7,000 ft. | 8 in. C. I pipe complete, 7 ft. trench. | 1.63 | 11,410.00 | 1.80 | 12,600.00 |
| 50 ft. | 10 in. C. I. pipe complete, 7 ft. trench. | 2.90 | 145.00 | 2.50 | 125.00 |
| 3 | 4 in. gate valves and boxes (cut in).... | 19.00 | 57.00 | 25.00 | 75.00 |
| 31 | 6 in. gate valves and boxes (cut in).... | 25.50 | 790.50 | 35.00 | 1,085.00 |
| 13 | 8 in. gate valves and boxes (cut in).... | 37.00 | 481.00 | 45.00 | 585.00 |
| 1 | 10 in. gate valve and box (cut in).... | 65.00 | 65.00 | 60.00 | 60.00 |
| 44 | (6 in. base elbow) hydrants..... | 75.00 | 3,300.00 | 75.00 | 33.00 |
| 21,000 | lbs. C. I. specials per lb. installed..... | .07 | 1,470.00 | .08 | 1,680.00 |
| 4 | 2½ in. overhead sprinkler cranes (each) | 43.00 | 172.00 | 40.00 | 160.00 |
| 10 | cu. yds. rock excavation..... | 3.50 | 35.00 | 7.00 | 70.00 |
| 3 | M. ft. B. M. sawed lumber, per M. B. M.. | 20.00 | 60.00 | 40.00 | 120.00 |
| 4 | M. sq. ft. sheeting and bracing, per M. sq. ft. ..... | 40.00 | 160.00 | 50.00 | 200.00 |
| 16 | cut-ins ..... | 30.00 | 480.00 | 10.00 | 160.00 |
| | | | $37,930.50 | | $41,670.00 |
| 150,000 | Gallon steel tank on 75 ft. steel tower | | $8,945.00 | | $9,000.00 |
| | Pump house inside dimensions 22x22 ft. in ground 10 ft. deep, 11 ft. to eaves above ground level..... | | 2,834.00 | | 3,085.00 |
| | Well 18 ft. - 0 in. dia. x 25 ft. - 0 in. deep | | 2,899.00 | | 3,000.00 |
| | Mechanical equipment, lighting. Mechanical equip. consisting of 150 gal. triplex, 500 gal. centrifugal (Worthington), 1-40 H.P. and 1-15 H.P. G.E. slip ring motor, switch panel, etc..... | | 5,868.00 | | ..... |
| | | | $58,476.50 | | $63,555.00 |

ance with the standards of the American Society of Testing Materials. At this letting there were some 70 contractors and material men present. About 40 sets of plans and specifications were out for figures and 27 actual bids were received. The contractor has agreed to take $70,000 worth of bonds at 5¾%. This proves the statement that now is the accepted time to proceed with municipal improvements and will show officials that large savings can be made to the taxpayers by so doing. The period in which construction may be done in the middle west is such that if improvements are to be made, this year, steps must be taken at once so that an early letting may be held.

## MOTORIZING THE FRESNO SCRAPER

*By E. M. Lagron, The Holt Manufacturing Co., Peoria, Ill.*

The Fresno or "Buck" Scraper is by no means a new tool in the hands of road building contractors. This piece of equipment has a long established record for economy in moving dirt a short distance, in road building, railroad work, levee building, land leveling and other similar work. Three-up and four-up teams with 4-ft. and 5-ft. Fresnos have made records which would have been impossible for any other method, so far as daily yardage is concerned.

Primarily designed to operate in loose, sandy soil, Fresnos within the last few years have proven their value by being successfully used in gumbo, hardpan, loose rock, gravel, heavy clay, black-jack and other severe soil conditions. Experience has taught that even the toughest and most resistent soil, after being plowed, may be economically handled by Fresnos on the shorter hauls at an extremely, and in fact, an astonishingly low cost per yard.

To those who are conversant with this form of dirt moving, this tool warrants no further discussion, but this article is directed to those who have not familiarized themselves with the usefulness and operating range of the Fresno.

*Recent Improvements in the Fresno.*

Recently considerable improvement has been made on the design and construction of the Fresno, and although originally intended to work with teams, they are now built for tractor operations. Their value, consequently, has increased two-fold. Daily yardages, decidedly impossible to realize with team-drawn Fresnos, are being consistently made by tractor Fresno outfits. Special hitches and larger Fresnos with particular loading and dumping devices, have made the tractor Fresno outfit a complete success. The loading and dumping is now being done by the operator from the seat of the tractor by means of powerful levers and pull ropes.

The 7-ft. Fresno holds approximately 20 cu. ft. of loose dirt. This size is not applicable to teams, but because of the

extra large load it carries and the power required to load it, it has been designed primarily for use with the smaller sized "caterpillar" tractors.

This scraper outfit not only takes a load that would be impossible for teams, but the tractor carries it for distances which would be entirely out of the range of teams. Only under the most extreme circumstances are Fresno team-drawn outfits used on a haul any longer than 200 ft. With the tractor-Fresno outfit, however, such distances have been handled at an extremely low cost per yard, and the yardage per day on such hauls has been known to average between 160 to 200.

Those who are contemplating handling their Fresno work with tractors should note that the greatest precaution should be exercised in the selection of both the scraper and the tractor. Although this outfit includes possibilities of handling work in an effective, efficient and highly profitable manner, unless the Fresno is strong enough to stand the constant punishment that the tractor will subject it to, a weak link will develop. The converse is equally true and if the tractor has not the "staying" qualities of workmanship and material in it to warrant standing up under continuous hard usage, the outfit can not succeed. For these reasons, it behooves those who are investigating this class of work to assure themselves that only the very best of this class of equipment is on their particular job.

*Records on One Job.*

The operation illustrated in this article is one which is proving extremely profitable. Engineer Ladd, when asked for information concerning the performance of this outfit, stated:

"We are hauling a yard of sand 200 ft. up a 20% grade in Lincoln Park, laying the foundation for the million-dollar Spreckels Soldiers' Memorial Building. The round trip is made in three minutes, and I am satisfied that the "caterpillar" and Fresno outfit can do the work of sixteen horses, or four-up scraper teams."

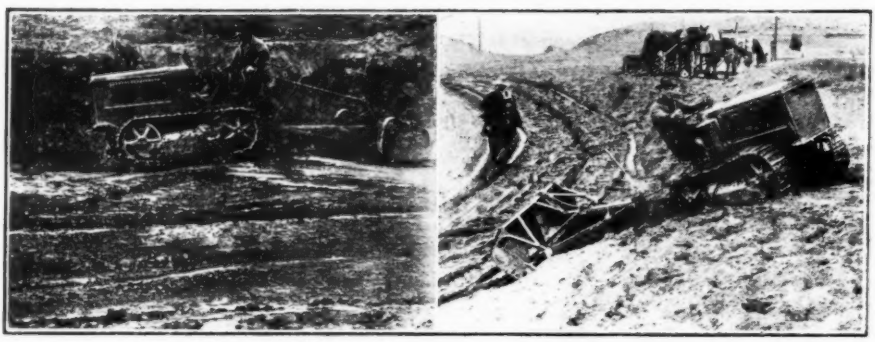
The cost of 16 head of stock, which Mr. Ladd estimates is replaced by the tractor Fresno outfit, is well known. The cost of operating the motorized outfit, based upon an almost uniform record, is as follows:

DAILY OPERATING COST

| | |
|---|---|
| 1 Tractor Operator @ $4.00 | $ 4.00 |
| Gasoline, 15 gal. @ 22c | 3.30 |
| Oil, 1 qt. @ 20c | .20 |
| Grease | .25 |
| Interest, depreciation, insurance and repairs | 6.90 |
| Total daily operating cost | $13.65 |

These costs as quoted, of course, are subject to local labor costs and other variables, but are fairly accurate, based upon conservative general conditions. The cost of the motorized outfit is less per day than the cost of four skinners for the four-up teams, which are easily required to do an equivalent amount of work. Added to this, the cost of team operation, feed, stable equipment, shoes and harness, which enter into team operations, and the decided contrast in favor of the tractor Fresno outfit, is quickly and obviously seen. The increased capacity and efficiency of the motorized Fresno outfit is even more pronounced in extremely hot weather, when teams are put out of business or their efficiency reduced far below normal.

Referring again to Mr. Ladd's statement, in which he advises that he can average a round trip on a 200-ft. haul up a 20% grade in three minutes, we are reasonably safe in assuming that by deducting for unavoidable delays, 8½ hours per day would well represent actual working time. At this rate 170 yds. of dirt were moved by the motorized 7-ft. Fresno outfit. The cost of this operation would be $13.65 per day, or the cost per yard would be 8c.



A MOTORIZED FRESNO SCRAPER IN OPERATION.

Certainly this is a very remarkable showing, and should warrant the closest scrutiny of those interested in this class of work. Using Fresnos on a 200-ft. haul is an extreme condition in the first place, but to move 170 yds. per day at 8c per yard is an enviable record.

## MACHINE TRENCHING TO A DEPTH OF 30 FT. AT ONE OPERATION

Thomas Haverty & Co., the well-known Los Angeles plumbing contractors, many years ago became firm believers in machine trench digging. They recently gained considerable attention through the digging of a 30-ft. by 30-in. trench at one operation. Since the P&H Ladder Type Trencher is designed for depths to a maximum of 18 ft., many looked upon this feat with doubt. However, those who

P & H LADDER TYPE TRENCHER EQUIPPED WITH BOOM EXTENSION CUTS TRENCH 30-FT. DEEP AND 30-INS. WIDE AT ONE OPERATION, LOS ANGELES, CALIF.

went to see the job found that a boom extension had been added (not recommended by the manufacturer, Pawling & Harnischfeger Co., Milwaukee, Wis.) Averages of 45 to 50 ft. per hour of deep trenches have been dug—720 ft. being dug with this machine working up 5 percent grade in one day. With the standard machine as shown in the accompanying illustration, 552 lin. ft. of 9 to 12 ft. deep trench 30 ins. wide was dug in four hours, working up an 8 percent grade.

## NEW POWER SHOVEL USES A DIESEL TYPE ENGINE

After a long period of experimentation the Bucyrus Company has developed the use of a Diesel type engine for a power shovel. The importance of this announcement lies principally in one outstanding fact: the fuel cost. This shovel, known as the Bucyrus 30-B oil shovel, will use as fuel any cheap, low-grade oil of high heat value which will flow freely.

The saving in the cost of fuel thus obtained is almost unbelievable. This machine has been under severe test for several months, under strenuous winter conditions, both as a shovel and as a dragline. These tests have shown that with fuel oil at 6c per gallon this machine will consume 1¾ to 2¼ gals. of fuel oil per hour. This means a fuel cost of 10½c to 13½c per hour, or, roughly, between $1 and $1.25 per day of average operation.

The phenomenal economies thus made possible to a shovel or dragline operator may be realized by comparison with a steam shovel of the same size. The fuel cost of any shovel differs widely in different sections of the country. Conservatively stated, however, such a shovel will burn about 1½ tons of coal in 10 hours. With coal at $6 per ton delivered, this means a daily fuel cost of not less than $9. A saving of $8 per day on fuel alone is thus possible. To this figure may be added several other items thus eliminated, notably, the saving made possible in not having to pay the cost of a team to haul water and coal.

To bring this home a little more forcefully, the resulting saving should pay the wages of the operator for the day with a considerable balance to spare.

The engine is of the full Diesel type, not the semi-Diesel. It is what is known as a mechanical injection engine, developing 55-H.P. at the conservative speed of 360 R.P.M. Its cylinders are 8 x 10½ ins. It is a heavy duty, slow speed engine of particularly rugged and heavy construction, adapted well to the severe service it must undergo in excavation work.

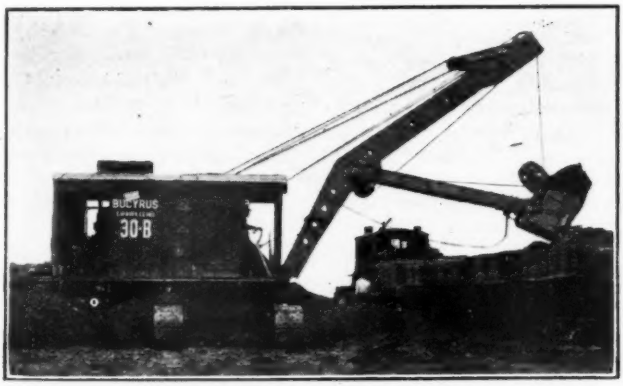
This Diesel type engine differs from the gasoline engine principally in that it is a constant pressure engine, the fuel being burned directly in the cylinders without the aid of a carburetor, spark plug or outside heating appliances. In the gasoline engine the mixture is taken into the cylinders, compressed, and then ignited by some auxiliary mechanism. The pressure then rises in the nature of an explosion. In the Diesel type engine the fuel is injected into the cylinders at a constant pressure in an atomized state. It is fired by the heat developed by the compression of air in the cylinders on the previous stroke. Thus the sudden pressure due to the explosions in the gaso-

line engine is eliminated, making the engine steadier running and easier to maintain.

The Diesel type of engine is no more of an experiment than a steam engine and is equally reliable. It is of a well tried design, being based on 20 years of engine builders' experience. Its especial value is the very low grade fuel that can be used with entire satisfaction, thereby revolutionizing the cost of operation for a machine of this size.

The 30-B oil machine, equipped with a Diesel engine, may be furnished either as a shovel, a dragline, a clamshell or a locomotive crane.

More detailed information may be obtained from the Bucyrus Company, South Milwaukee, Wis., upon application.




BUCYRUS POWER SHOVEL OPERATED BY A DEISEL TYPE OF OIL ENGINE.

## CORE DRILLING MACHINE TEST CAUSES REJECTION OF AN INDIANA PAVEMENT

In making final settlement with a road contractor the Indiana State Highway Commission recently refused to pay for 1,128 ft. of concrete pavement which is not of the thickness required by the specifications, and $5,700 was deducted from the final estimate given the contractor.

The "gift" pavement comes as a result of the activities of the highway department in using a core drilling machine to test all pavements before receiving them and making final settlement, and in this case it was disclosed that certain parts of the pavement were not up to the specifications. The discovery has also resulted in five inspectors and engineers employed by the highway department on this particular project being dismissed.

The work of the core drilling machine and the taking over of 1,128 ft. of pavement on this road, divided into intervals of 100 ft. or more in stretches extending for approximately 11 miles between Dyer and Deep River in Lake County, brings to light some interesting facts in state highway construction.

According to commission members the pavement in question is, to the eye, apparently up to every requirement. However, when the core drilling machine was put to work cutting out cores every few feet to determine the thickness of the pavement, it was disclosed that materials were skimped and the thickness on the sides as well as in the crown of the highway were deficient of specifications over a distance of 1,128 ft. The commission refused to settle with the contractor for this inferior mileage, leaving the builder the alternative of tearing up and rebuilding this section, or giving the inferior pavement to the state. The latter selection was made. It is now up to the state to rebuild this section when it goes bad.

The core drilling device was added to highway department equipment several months ago for the express purpose of seeing that roads are built of the thickness required by the specifications. There is no getting away from the final results, for when a core is removed from a completed pavement prior to final settlement between highway department and contractor, the commission knows positively if the road is up to standard.

## SANITARY SEWERAGE SYSTEM

Notice to Bidders

Huntingburg, Ind.

Sealed proposals will be received by the "Honorable Mayor and Common Council" of the City of Huntingburg, Ind., until 8 P. M., June 6th, 1922, at which time they will be publicly opened and read.

A cashier's check or certified check on a local bank, to the amount of $5,000.00 made payable to the City Clerk must accompany each bid.

The sewer work consists of approximately 8 miles of 8 in. to 12 in. sewers, 91 manholes, 9 flush tanks and settling tank.

Proposals must be marked "Proposal for Sanitary Sewerage System."

The city reserves the right to reject any or all bids.

A set of plans and specifications may be obtained from the engineer upon a deposit of $16.00. Specifications only, $6.00 deposit. Any one plan, $4.00 deposit. Seventy-five per cent of all deposits will be refunded upon the return of plans and specifications to the engineer's office not later than June 16, 1922. Bid sheets are in the specifications, and a bid submitted will also be considered a return of the specification.

Louis Wagner, Mayor.
Cossie M. Day, City Clerk.

Frank L. Wilcox, Engineer,
Chemical Building,
St. Louis, Mo.


## FOR SALE

Best 60 H.P. Track-laying tractor, overhauled, repainted, practically as good as new. Immediate delivery. For price and special terms, address

H. W. Chown,
305 Merchants Bank Bldg.,
Indianapolis, Ind.


# Contracts Awarded

### ROADS AND STREETS

**Ala., Athens**—A. J. Waldrop, Knoxville, Tenn., will probably be awarded contr. by St. Hwy. Dept., for constr. of hard surf. rd., from Athens to Lauderdale. Bid on mac. penetration $384,101; on conc. penetration, $422,690.

**Ala., Birmingham**—Following roads contracts let; Ensley, Hulga, Wylam & Docena Roads to Independent Paving Co., at $223,029; Warrior to Robbins crossroads to C. P. Parsons, at $61,300; Mulga-Port of Birmingham Rd., to Wallace Bros., at $62,350.

**Ala., Florence**—Goodson Constr. Co., Knoxville, awarded contr. for construction of Rogersville Rd., at $165,000 (14 miles).

**Ark., Marion**—U. V. Thornton, Searcy, Ark., awarded contract by Critenden Co., Commrs., Dist. No. 6, at $350,000; 30 mile gravel rd. around Earle.

**Cal., Oakland**—Heafy, Moore & McNair, awarded contract for constr. of modern conc. roads betw. Hayward and St. Eden and bet. E .14th St. and San Lorenzo, at $117,655.

**Colo., Sacramento**—Standard Industrial Engrg. Corp., San Francisco, awarded contract for grading and surfacing with gravel 10.98 mi. state hwy. in Monterey Co., betw. San Lucas and 2¾ mi. east of Long Valley school, at $138,830.

**Colo., Colorado Springs**—The Stratton Est., awarded contract by Council for paving city and street-car portion of paving program, including right-ofo-way of street car lines on 4 streets, at $151,007.

**Ga., Atlanta**—MacDougal Constr. Co., Healey Bldg., awarded constr. for 14,190 sq. yds. Marietta St.—Peachtree to Bartow Sts., at $99,049; 3675 sq. yds. Decatur St.—Peachtree to Ive Sts.—at $25,652; foregoing with granite blk. on conc.; 10,305 sq. yds. Decatur St.—Ivy to Yonge Sts., conc., $71,351.

**Ind., Indianapolis**—Carpenter Constr. Co., Terre Haute, awarded contract by State Hwy. Commission to pave one sect. of National Hwy.—stretch of 6.897 mi. bet. Putnamvill eand point 1½ miles east of Mt. Meridian—with brick at $210,916.78. Road will have conc. base.

**Kans., Garden City**—M. R. Ammerman, Wichita, awarded contract to build 6 miles hard surf. roads in Finney Co., at $174,000.

**Kan., Topeka**—Stewart & Ritchie, Wichita, awarded two paving contracts at $154,812; List & Hallett, Kans. City, Mo., contr. for Elmont spur paving at $69,308.

**Md., Baltimore**—L. R. Wacache, Thurmont, Md., awarded contract to construct 1.99 mi. St. Hwy. from end of Cont. F-27A to Urbana, at $49,990 (Concrete); Warp Bros. & Pyles, contr. to constr. 3.34 mi. St. Hwy. on York Rd., Baltimore Co. Cont. B-35, at $85,600; Thomas, Bennett & Hunter, contr. to construct 3.75 mi. St. Hwy. from New Windsor to Union Bridge, Carroll Co. Cont. C1-25, at $123,885; E. R. Griffith, Contraction Co., at $109,182, to construct 4.19 mi. St. Hwy. along Philadelphia Rd. to Bush; conc., Harford Co., Cont. 4-27 .

**Mass., Boston**—D'Onfro Bros., 700 Main St., Leo-


Send
35 Cts.
Today

# The NON-SKID Ink Stand
## Will "Stay Put"

**We guarantee *it will not slide* even if used on a slanting drawing board, unless same is inclined to an angle of more than 27½ degrees.**

**A cork insert at bottom forms a vacuum and holds the stand wherever it is placed.**

**Heavy enough to be used as a paper weight as well.**

**PRICE, 35c,** POSTPAID
$3.50 Per Dozen.

**KOLESCH & CO.**

**138 Fulton Street New York**

K TRADE MARK

minster, awarded contract by St. Hwy. Dept. for paving 14,000 ft. highway, Palmer & Madison, rein. conc. at $149,536; Coleman Bros., Medford St., Charlestown, awarded contract for paving 56,000 ft. Newburyport Turnpike, Danvers & Topsfield, 18 ft. rein. conc. and bitum. macadam, at $503,831; 3500 ft. hwy. Bingham, 18 ft. conc. and bitum. macadam, to J. D'Aloi, Woonsocket, R. I., at $37,458.

**Mass., Springfield**—Candella Co., Milford, Mass., awarded contract for bldg. Southwick and Granville Rd., at $301,531.

**Mich., Ironwood**—W. S. Peters, Wakefield, awarded contract for construction of Tula Rd., at $112,000; macadam, 10 miles from Wakefield to Tula.

**Neb., Chadron**—Roberts Constr. Co., 404 First Natl. Bank Bldg., Lincoln, awarded contract for constr. of Paving Dist. No. 2 ;Topeka type asphalt paving, at $125,837.

**N. J., Freehold**—J. J. Barrett, 147 Lafayette St., Trenton, awarded contract for reconstructing Ocean Ave., Sea Bright and Monmouth Beach Boros.; sheet asph., at $160,000; Utility Constr. Co., 5 Spring St., New Brunswick, awarded contract for reconstr. of State Hwy., Route 4, Sec. 6, Etontown to W. Long Branch; sheet asph. on conc., at $187,569.

**N. J., Red Bank**—S. S. Thompson & Son, Red Bank, awarded contract for reconstr. of Adelphia-Farmingdale conc. road, at $118,183. Road is 3½ miles in length, 20 ft. wide .

**N. J., Trenton**—Michael Straub, awarded contract by Gloucester Co., for constr. of sect. of Camden-Salem Rd., also one for bldg. Adelphia-Farmingdale Rd. Monmouth awarded to S. S. Thompson, Inc., Red Bank, at $203,660 and $118,882, respectively.

**N. M., Santa Fe**—Following road contracts let on No. 78, San Miguel Co.—Las Vegas to Watrons, 17.7 miles; grading, draining and crushed limestone surfacing, to Atlas Constr. Co., at $80,338; McKnight & Hamer, Amarillo, Tex., contract for similar work on 33.8 miles, FAP 79, at $74,343; J. R. Dooley, Santa Fe. constr. for 12.8 mi. Moreno Valley; grading, draining, gravel and crushed rock surfacing at $54,912.

**N. Y., Albany**—Following contracts let for impvt. of 2.47 mi. Hwy. 1613, Broome Co. to J. C. Haynes, Watertown, $97,620; 6.6 mi. Hwy. 1613, Broome Co., to Stento & Serafini, 84 Court St., Binghamton, at $166,164; 2.84 mi. Hwy. 1480, Cattaraugus Co. to Cold Spring Constr. Co., Ellicott Sq., Buffalo, at $96,646; 1.91 mi. Hwy. 1611, Cattaraugus Co. to G. Metzger, Jr., 12 E. 4th St. Emporium, Pa., at $61,152; 3.5 mi. Hwy. 8091, Fulton Co. to Norwich Constr. Co., Inc., Norwich, at $91,158; 2.76 mo. Hwy. 1481, Monroe Co to F. W. and J. J. Crouch, Rochester, $68,734; 1.06 mi. Hwy. 1610, Oneida Co. to N. D. Peters &Co., 216 Kossuth Ave., Utica, $52,804; 8.08 mi. Hwy. 8092, Wyoming Co., to Constantine Constr. Co., 240 Dewey Ave., Buffalo, at $333,302.

**N. Y., Geneva**—J. H. Gallup, Union Blk., Syracuse, awarded contr. for paving various streets; sheet asph. on 5-in. conc., at $101,777.

**N. Y., Watertown**—Bd. of Supvrc. Jefferson Co., will construct 50 miles macadam hwys. by Day Labor, under supervision of H. S. Ball, County Bldg., Co. Supt. of Hwys., Arsenal St., at $350,000.

**N. C., Raleigh**—State Hwy. Comm., let contract for grading and penetration macadam paving 5.96 mi. State Proj. 866, Polk Co., to Dunn & Woodall, Trust Co. of Georgia Bldg., Atlanta, Ga., at $144,-144; 4.49 mi. St. Proj. 492, Warren Co. to Porter & Peck, Greenville, at $86,840; grading and top-soiling 4.5 mi. State Proj. 724 Caldwell Co. to Caldwell Co., Rd. Comm., Lenoir, at $24,440; rein. conc. bridges and culverts to R. M. Thurmond, Lynchburg, Va., at $22,620; 3.07 mi. St. Proj. 601, Alexander Co. to G. Ginn, Inc., Gastonia, $18,539; Rein. conc. brdges. & Culvts. to R. M. Thurmond, Lynchburg, Va., $13,000; grading, paving, 2-in. Topeka on 5-in. conc, 10 mi. State Proj. 903, Buncombe Co. to 9sheville Paving Co., Asheville, at $85,163; clearing, grading & waterbound macadam surfacing 11.85 mi. State Proj. 951, Jackson Co. to R. H. Wright & Son, Asheville, $189,250; grading, rein. conc. paving and rein. conc. brdgs. and culverts on 8 miles Stfl Proj. 588, Rockingham Co. to Cheatwood & Driscoll, Richmond, Ca., at $242,280.

**O., Paulding**—Sol Putnam, Van Wert, awarded contract for bldg. no. port of Wayne Hwy. Van Wert Hwy., at $149,997.

**Ore., Baker**—Oxman & Harrington awarded contr. by County Court for constr. of Baker-Cornucopia post road, at approx. $108,000. Work involves grading 13½ miles.

**Ore., Portland**—Simon & Johnson, awarded contract for impvt. of Foster Rd. from Powell Valley rd. to E. 72nd st., at $152,303.

**Ore., Portland**—Montague-O'Rielly Co., awarded contract for grading Carvice Creek section of John Day Hwy., Gilliam Co., 11 miles, at $154,350.

**Pa., Harrisburg**—Dunleavey Brothers Co., Coatesville, Pa., awarded contract to build 15,128 ft. one-course rein. conc. and Hillside vit. brick roadway on Route 225, Radnor Twp. Delaware Co., at $134,758.

**Pa., Phila.**—Contract let for paving Lancaster Ave. and 5th St. to Barber Asphalt Paving Co., Land Title Bldg., at $55,600 and $39,000 respectively; grading Jefferson St., to E. A. Mullen, 5512 Vine St., $28,200; furnishing and setting granite and conc. curbs in various streets, to J. J. McHugh, 1430 S. Penn Sq., at $69,000.

**Pa., Shippensburg**—Development & Constr. Co., Baltimore, awarded contract for road work in Cumberland Co., at $204,322. Proj. calls for 34,526 ft. one-course rein. conc. roadway, 16 ft. wide.

**Pa., Williamsport**—Busch & Stewart, Williamsport, Pa., awarded contract for 22,000 sq. yds. 4-3 in. vit. brk. pavink on Park, Campbell, Walnut, Hepburn, Front, Court, Jefferson and Oliver Sts., at $88,100; Central Constr. Corp., Harrisburg, Pa., awarded contract for 42,859 sq. yds. 3-in. Trinidad sheet asph. paving on Park Ave., Franklin and W. Third Sts., at $153,293.

**S. C., Greenwood**—City let paving contracts as follows: Case & Cothran, Atlanta, Ga., 50,000 sq. yds. roadway pavement; Greenville Paving Co., Greenville, S. C., 18,000 yds. walk paving; both conc., at total cost of $200,000.

**Tenn., Lawrenceburg**—Smith, Pitts & Son, Mt. Pleasant, Tenn., awarded contract to grade and surface 15.65 mi. St. Hwy. 51 bet. Lawrenceburg and Wayne Co. line, Lawrence Co., at $103,854.

**Tenn., Memphis**—Hansen Constr. Co., Blytheville, Ark., awarded contract for conc, surfacing of road from Marked Tree to no. line of Crittenden Co., at $260,000. Hwy. will be about 10 miles in length.

**Tenn., Nashville**—Hughey Bros., Memphis, Tenn., awarded contr. for 12 miles of road, Carroll Co., at $90,000; Moore Brothers, awarded contract for chert surfacing 20 mi. rd. Lewis & Lawrence Cos., at $63,000.

**Tenn., Nashville**—Smith, Pitts & Co., Mt. Pleasand, Tenn., awarded contract for 15 miles of highway at $103,854.

**Tex., Amarillo**—Plains Paving Co., Wichita Falls, Tex., awarded contract for paving at $450,000.

**Tex., Dallas**—Uvalde Paving Co., awarded contract to pave Clinton St.,—King's Hwy. to so. city limits—at $93,000.

**Tex., San Angelo**—O'Connor, Smith & Co., Dallas, Tex., awarded contract to pave 4 miles streets, at $263,000; also at $40,800 to pave 4 suburban blks.

**Tex., Wichita Falls**—Wichita Co. Judge, J. P. Jones sublet contr. to Tibbetts Constr. Co., 209½ W. 8th St., Ft. Worth, for constr, of 4.2 mi. conc. pavement betw. Wichita Falls and Clay Co. line at $129,702. McCollum Constr. Co., 1507 F. & M. Bank Bldg., Ft. Worth, to constr. 4.4 mi. conc. paved rd. no. of Electra, at $143,997.

**Va., Charlottesville**—Maloney Paving Co., 3817 Alton Pl., N. W. Washington, D. C., awarded contract to construct conc. paving, 15 ft. wide and 5-7-5-in. deep, at $125,000.

**Va., Pearisburg**—Worden Constr. Co., Pulaski, Va., awarded contr to construct 6.19 miles bitum. macadam betw. Ripplemead and Hoge's Store, Route 23, Giles Co., Proj. 128-A at $119,134.

**Wn., Hoquiam**—Grays Harbor Constr. Co., local awarded contr. for paving 4-mile stretch of Olympia Hwy. betw. Montesano and Brady, at $105,452.

**Wash., Seattle**—Jahn & Bressi, Thompson Bldg., Seattle, awarded contract for brick paving on First Ave. and First Avenue south, at $649,199.

**Wn., Seattle**—D. W. Miley, Everett, awarded contract by Board of Skagit Co. Commrs., to pave 6¼ miles of highway betw. Hamilton and Lyman with 7-in. concrete, at $143,624.

**Wn., Seattle**—McHugh Constr. Co., awarded contract for clearing, grading, draining and paving with one course conc. about 4.18 mi. Sunset Hwy. betw. Sunnyslope and East Cashmere in Chelan Co., FAP 99, at $129,834; clearing, grading, etc. abt. 3.71 mi. Olympia Hwy. betw. McCleary and

Thurston Co. line, Grays Harbor Co. FAB 101, to Indiana Asph. Paving Co., Seattle, at $118,553; similar work on 1.40 mi. No. Bank Hwy. bety. Ellsworth and Camas, Clarke Co., FAP 36, to G. P. Warren, Seattle, at $39,168.

**W. Va., Charleston**—State Road Commission awarded following road contracts: Smith & Qwynn, Parkersburg, W. Va., awarded contract for 5.3 mi. conc. at $150,600, Wood Co.; J. M. Lipscobe & Bro., Glenville, W. Va., 8.77 mi. Webster Co. at $85,303; 5.27 mi. Bitulithic conc., Ritchie Co. at $187,370 to Smith & Qwynn; Cisler & Morse, Marietta, Ohio, 3.76 mi. conc., Monongalia Co., at $138,272; R. H. Anderson, Fayetteville, W. Va., 1.48 mi. Kanawha Co.; 1.6 mi. conc., to Cisler & Morse, Marietta ,O., Marion Co., at $56475; Jno. E. Dougher & Sons, Union, W. V., awarded contr. for .98 miles bilulithic macadam at $29,000; Thompson & Doss, Barboursville, W. Va., contr. for .84 mi. conc. Logan Co. at $31,600; Roane Co., 3.7 mi. conc. at $116,660 to Cisler & Morse, Marietta, O.; .13 mi. grading, Mingo Co., at $4842 to Rogers & Shumway, Worthington, W. Va., at $4,832; 1.91 mi. conc., to Engstrum & Knapp, Wheeling, Ohio Co., at $72,876! 4.24 mi. conc. at $171,017 to Paul S. Haner Co., Clarksburg, Harrison Co.; 2.03 mi. Bithulithic macadam at $69,900 to E. K. Newell, Waynesville, Ky., at $69,900; 5.49 mi. Gravel, Mason Co. to Tulley Constr.

**WiS., Elkhorn**—Following contracts let for constr. of 17 miles conc road in Walworth County: Elkhorn-Burlington Roads, Henry Horst, Rock Island, $129,787; Lake Geneva-Walworth Rd., States Impvt. Co., Chicago, Ill., at $127,848.

**Wis., Janesville**—R. R. Birddall, Racine, awarded contr. for constr. of Beloit-Delevan and Beloit-Clinton Roads; 7 miles, at $108,471.

**Wis., Jefferson**—Following contracts let for road work: Jefferson-Ft. Atkinson Rd., Proj. 296, to Webb & Dixon, Albany, at $97,619; Jefferson-Cambridge Rd. Proj. 28, to Jos. P. Connell, Janesville, at $32,147; Jefferson-Johnson Creek Rd. Proj. 254, to Jos. Connell, Janesville, at $78,348.

**Wis., Racine**—L. L. Tindall, Waterford, awarded contract for constr. of Windlake Rd., at $122,814.

**Wis., Sheboygan Falls**—Robert Reisinger Co., 464 Oakland Ave., Milwaukee, awarded contract for paving at $106,905; 2-course conc. 24,000 sq. yds. rein. conc., 5900 sq. yds. conc., 832 sq. yds. paving in street car section, 12,000 cu. yds., grading.

**Wis., Wisconsin Rapids**—Following contracts let for road work: Wisconsin Rapids-Pittsville-Neillsville Rd., to Niehaus & Stahl, Greenleaf, at $52,476; Marshfield-Pittsville-Babcock Rd., to Ule Paving Co., Stevens Point, at $63,779; Rudolph- Rapids Rd., to Peppard & Fulton, Superior, at $58,360.

**Wis., Wisconsin Rapids**—Marshfield-Neillsville and Marshfield-Pittsville-Babcock Rds. contract let to Iron River Constr. Co., Iron River, Mich., at total of $130,343.

## SEWERAGE AND SEWAGE TREATMENT

**Cal., Dinuba**—De Waard & Cobham, 207 Granger Bldg., San Wiego, awarded contract for sewage disposal works at $122,700. Contract includes reinf. conc. ejector pit and bldg., 40x40 ft.; 3 500-gal. ejectors; 2 compressors! two 30 h. p. motors; 2 air receivers; 4 reinf. conc. settling tanks and 2 sprinkler beds.

**Cal., Englewood**—Contract for 8-18 in. vit. clay pipe in Lateral Sewer Dist. No. 1, to D. S. Reid Constr. Co., Littleton, aat $87,632; 8-18 in. vit. clay pipe to Gordon Constr. Co., Barclay Bld., Denver, at $32,040.

**Cal., Pasadena**—De Waard & Coblan, 207 Granger Bldg., San Diego, awarded contract for constructing sewerage system in San Rafael Heights, 11,004 ft. 8-in., 4295 ft. 10-in., 1396 ft. 12-in and 1435 ft. 14-in. vit. pipe, etc., at $106,660.

**Can., Santa Monica**—J. Chutuk, 426 Bullard Bldg., Los Angeles, awarded contract for constr. of 58,000 ft. 12-in. conc sewers and 40,000 ft. cement curbs on Penn. Ave., at $65,048.

**Cal., Watts**—B. D. Baucus, 173 W. 43rd St., Los Angeles, awarded contract for sewerage system: 123,449 ft. 6-12 in. conc. pipe, at $484,000.

**Ont., Hamilton**—J. H. McKnight Constr. Co., Ltd., Toronto, awarded contract for constr. of Sec. No. 3, Western Storm overflow sewer, at $192,700.

**Conn., Wethersfield**—B. Silvestrd, 249 Otis St., Hartford, awarded contract for 5,000 ft. 24-in. tile sewer, 30,000 ft. various smaller sizes, tile sewers and one 35x70 ft. settling tank, at $200,000.

**Ill., Rock Island**—Frazier-Davis Constr. Co., Arcade Bldg., St. Louis, Mo., awarded contract for 14-24 in. vit. rile drains, at $49,000.

**Ind., Indianapolis**—Following contracts let by Bd. San. Commrs. for power plant equipt. and appurts. for disposal plant: 3 400 hp. water tube boilers, to Babcock & Wilcox Co., S. Dearborn St., Chicago, and 3 stokers to Green Eng. Co., East Chicago, Ind., total $45,990; 3 steam turbo blowers to Dravo-Doyle Co., 808 Merchants Bank Bldg., $53,348; 2 elec. generator units, 5 surf. condensers and one switchboard to General Elec. Co., Traction Terminal, at $66,501; mechanical equipt. for sludge remover to Link Belt Co., W. Mich. & Holmes St.s., $4818; 4 drilled wells, 80 ft. deep, to J. W. Henslet, 313 N. Capitol Ave., $2992.

**Ia., Clinton**—W. B. Carter, United Bank Bldg., Sioux City, awarded contract for constr. of san. sewers at $49,952; clay sewer pipe, 2000 ft. 30-in, 400 ft. 27-in., 800 ft. 24-in and 10,000 ft. 84- in.

**Md., Baltimore**—Ryan Constr. Co., Phila., awarded contract to construct storm water drain from East and Fairmont Ave. to Fayette and Third Sts., at $101,000.

**Md., Towson**—Thoney Pietro & Co., Morgantown, W. Va., awarded contr. to construct sewerage system at $69,255; U. S. Engrg. Co., 205 W. Lombard St., Baltimore, contract to build disposal plant, at $34,210.

**Neb., Omaha**—Following contracts let for sewers: 16th Street to Connolly & Fitch, at $61,159; 28th St., to Omaha Constr. Co., at $6267; Happy Hollow Blvd., 1th to Charles, to H. J. Peterson Co., 403 Farnam Bldg., Omaha, at $9050; 33rd St., T to W Sts., to Gus Carlson, 4205 Pacific, Omaha, at $1876; Charles—49th to 51st—to Jno. S. Farrell, at $2190.

**O., Toledo**—Whitney Constr. Co., awarded contract for sewers in Sheridan Pl., at $45,279.

**Pa., Johnstown**—Contract for Sec. 4, Main Sewer —19th Ave. to Johns St., let to A. L. Anderson & Bros., Inc., Altoona Trust Bldg., Altoona, at $200,000; Sec. 5, Main Sewer, to M. O'Herron Co., Bigelow Blvd., Pittsbugh, at $113,493.

**Pa., Phila.**—Contracts awarded for sewer in Comley and Powell Sts., to A. Di Sandro & Sons, 3906 N. 5th St., $3830; 21st St. to E. Leva 3851 N. 10th St., $22,850; 66th Ave. N. to D. Peoples, 742 E. Penn. St., at $27,991; 52nd & Diamond Sts., to F. Joffola, 1203 Tree St., $8942; Montgomery & Lebanon Aves., to F. T. Buckins, 4050 Kensington Ave., $6218 and $9050, resepectively.

**S. C., Florence**—Chitwood & Palmer, awarded contract for storm drains and sewers at $68,455.

**Tex., Amarillo**—Gordon Constr. Co., Denver, Colo., awardede contr. to construct sewers, at $60,000.

**Tex., Breckenridge**—McKenzie Constr. Co., awarded contract for constructing sewer system; 12 miles piping $235,000 available.

**Tex., Greenville**—N. D. Duck, awarded contract to construct storm sewer system, at $59,824.

## WATER SUPPLY AND PURIFICATION

**Ark., Little Rock**—Public Utilities Co., awarded contract to constr. water and light systems in Park Hill Addn., at $53,100.

**Que., Montreal**—Canadian Iron Foundries Co., Ltd., St. Maurice St., Three Rivers, Que., awarded contr. by City Council for cast iron pipe at $40,000; Canadian Westinghouse Co., Ltd., 285 Beaver Hall Hill, contr. for elec. equipt. for elec. pumping station, at $88,000.

**B. C., Vancouver**—Pacific Coast Dredging & Contracting Co., Ltd., 904 Standard Bank Bldg., Vancouver, awarded contarct for constr. of water storage dam at Anyox, by Branby Mining & Smelting Co., at approx. $350,000, for constr. of dam, while other incidentals such as constr. of temp. tramway to take in material, installation of pipe, penstocks and hydro-elec. machy. will involve total outlay of about $500,000.

**Conn, Hartford**—Chicago Bridge & Iron Works, 3149 Hudson Terminal, New York, awarded contract by Underwood Typewriter Co., for steeel pump house, water tower and tank at plant, at $30,000.

**Ill., Joliet**—D. R. Kuehn, Aurora, awarded contract for 4-6 in. cast iron mains, hydrants, valves, etc., in Herkimer St., at $40,000.

**Ia., Edgewood**—Contracts for 10,120 ft. 4-8 in. c. i. pipe, 3000 ft. 2-in. galvanized pipe, special

castings and 20 hydrants, to C. W. Rowland, Des Moines, at $11,421; 50,000-gal. steel tank and tower, pumping machy. and pump house to Pittsburgh-Des Moines Steel Co., 9th and Tuttle Sts., Des Moines, $44,017; well to J. E. Emery, Cedar Rapids, at $1,000.

**La., New Orleans**—Sewerage & Water Bd. let contracts for 2 water boilers, 599-1800 hp. capy., to Lasker Iron Wks., 3201 S. Lincoln St., Chicago, at $28,915; elec. equip. to Westinghouse Elec. & Mfg. Co., Union Bldg., Pitssburgh, at $20,575; two-36-in. centrif. pumps, 30,000,000 to 40,000,000-gal. daily capy. and 2 motors, to Delier Pump & Machinery Co., 165 Bway., New York, at $9,000.

**Minn., Duluth**—Peppard & Fulton, 217 Bd of Trade Bldg., Superior, awarded contract for Endion reservoir at $184,523.

**N. Y., Brooklyn**—N. B. Stefano, 257 Glenn Ave., Tompkinsville, awarded contract for mains in Flatbush Ave., Aves. T & U, Coleman and Hendrickson Sts., at $28,571; Manhattan and Green point Aves., to Carter Cont. Co., Inc., 582 78th St., at $48,167; Oceanview, Skillman, and 17th Aves., Barrett, Cleveland, Pine, W. 8th, E. 21st Sts., etc. to Paladino Contg. Co., 337 E. 120th St., New York, at $12.295.

**N. Y., New York**—Norton Eng. & Contg. Co., 51 W. 149th St., awarded contr. for mains in Brook, Jerome, Tremont and University Aves., E. 143rd, E. 177th and W. 177th Sts., at $116,729; C. Delblasio, 339 7th Ave., Mt. Vernon, awardede contract for mains in Buhre, Cranford, Cromwell, Manhattan and other streets in Bronx, at $18,115.

**N. C., Raleigh**—Contr. for extension and impvts. to water works, let as follows: Contr of impounding reservoir, area 116 acres, including dam to Va. Machy. & Mill Co., for $64,381; steel tower and tank to contain 600,000 gal. at $21,568 to R. D. Cole Mfg. Co.; found., for tower and tank, $4900. City will lay pipe line, purchasing own material total cost $115,676, including 4380 ft. 20-in., 6600 ft. 12-in., 15,468, 8-in., 12,050 ft. 6-in. and 3870 ft. 6-in. main to be replaced by larger main and used for further extension; add 50 fire hydrants; dam of new impounding reservoir of earth 30 ft. high with conc spillway, providing supply of 400,000,000-gal. covering 116 acres; present area 77 acres and 150,000,000 gal supply; addition to equipt. to cost in all $215,619 giving complete supply to all parts of City. rFuther development of pumping sta. filter houses etc. to be considered later. E. B. Bain, Supt. in charge of main exten.

**O., Cleveland**—Peter F. Connell, Kent. O., awarded contract for laying steel water mains from Kirkland Pumping Sta. to new water wks. reservoir on Baldwin Rd., at $510,670.

**O., Cleveland**—Rice & Jones Co., 1836 Euclid Ave., awarded contr. for 18x24 ft. brk. pumping station, at $4980; 6530 ft. mains to Lannahan Constr. Co., Marshall Bldg., at $22,222; 14,650 ft. mains to D. Pfahl &Co., Guardian Bldg., at $69,761.

**S. C., Walhalla**—Henry Constr. Co., Greenville, S. C., awarded contr. for water plant; conc., at $125,000.

**Wn., Seattle**—Grant Smith & Co., Henry Bldg., awarded contract for installation of an all steel pipe line from Molasses Creek to Volunteer Park Reservoir—a trifle over 14 miles. Work involves everything buck backfilling. Contr. price $1,468,-602.50.

**Wn., Walla Walla**—Pacific Coast Paving Co., Perking Bldg., Tacoma, awarded contract for constr. of twin reservoir at $176,841.

# Prospective Work

## ROADS AND STREETS

**Cal., San Bernardino**—Bids will soon be asked for constr. of Deep Creek cut-off—about 15 miles—to be built jointly by state and Federal Govt., $105,000 voted by state wor work; balance will be from Fed. funds. Work will be under joint supervision of Co. Surv. E. T. Ham and C. H. Sweetser, Dist. Engr. Bureau Pub. Rds., U. S. Dept. of Agriculture.

**Cal., Santa Rosa**—Hwy. Comn., will construct entirely new rd. over St. Helena mountain betw. Napa and Lake Cos. Comn. has $180,000 in budget for work. N. D. Darlington, Chrmn. of Comn.

**Colo., Denver**—Springs-Limon Road will be completed this summer at cost of $76,000. It is also reported that 1.4 mi. conc paving will be built on road betw. Littleton and Sedalia. Another proj. statement on same hwy., not yet approved, has been received. Cost will be abt. $46,000, the Government to pay usual share.

**Fla., Jacksonville**—Ests. of cost for pacing 4 streets in Riverside submitted to City Comn. by City Engr. sheddan. Paving estimates $77,665; sewers, $34,000.

**Ga., Brunswick**—Board of Commrs., Glynn Co., appropriated $75,000 for completion of Broadfield Rd. leading from Buffalo Swamp on Jacksonville Hwy., road will also be completed at once. Approx. $150,000 will be expended on impvts. to highways within next few months.

**Ill., Moline**—Council adopted Ords., providing for impvts., costing approx. $85,073. Largest of the impvts. is the 21st Ave. paving dist. Est. cost $57,820. 11th Ave—C from 27th to 22nd St.; 29th 11th Ave. C to 12th Ave. will be paved with concrete. Est. $20,995; alley bet. 15th and 15th A., from 21st to 23rd, conc. pavement. Est. $2611; alley betw. 14th and 15th Aves., from 26th to 27th Sts., conc. pavement, $2297. Sewe rand water main on 20th St.—19th Ave. 1 blk. so. $1350.

**Ia., West Union**—Resolution adopted by City officials to lay 40 blks. of paving during summer months. H. R. Green, Engr. Cedar Rapids, will prepare plans. Est. cost $140,000 for the paving.

**La., Baton Rouge**—City Comn., will expend about $639,788 to hard-surface or gravel 23 miles unimproved streets; $66,548 for 96,500 ft. sub-surface draining. Jno. J. Mundinger, Engr.

**La., Monroe**—City will pave 5 miles of streets. Est. cost of construction, $300,000, or $60,000 per mile, as a full-width city pavement will be built.

**La., New Orleans**—State Hwy. Dept. plans 55 mi. rdway betw. New Orleans and Hammond, including dredging swamp in vicinity of Pontchatoula; also 8 ft. canal from 40-50 ft. wide from Pontchatoula to La Branche. Cost $7,000,000. Work will start within 60 days and it is estimated it will take 3 yrs. to complete same. J. M. Fourney, St. Hwy. Engr.

**Md., Baltimore**—State Roads Comn., 601 Garrett Bldg., will expend $4,800,000 to improve state highways; $3,000,000, including Fed. and State Aid, etc.; $1,800,000 for new constr. including Baltimore Southern Maryland Hwy.

**Md., Frostburg**—$50,000 bonds voted here for strfeet impvts. It is conservatively estimated that over $300,000 will be expended on street, sewer and personal property impvts. within next 24 months.

**Mich., Detroit**—City Council voted to allow appropriation in budget of Dept. Pub. Wks. of $1,200,-000 for resurfacing and widening 3 streets.

**Minn., Thf. River Falls**—Petition of Bd of Commrs. Beltrami Co., asking permission to construct rd. across Red Lake Indian Reservation, has been granted by Dept. of Interior.

**Minn., Winnebago**—Bids will be asked abt. June 1st for 8 blks. paving. Bids will be asked on various types. Cons. Engr. L. P. Wolff, 1000 Guardian Life Bldg., St. Paul. R. L. McMillen, Vil. Clk.

**Miss., Pascagoula**—Jackson Co. bd. of Supvrs. and Miss. State Hwy. Comn., Meridian, will expend abt. $387,000 to construct perm. hwy. across county; $95,000 for Dist. 2 with Moss Point principal City; $112,000 for Dist. 3, including Pascagoula; $180,000 for Dist. 4, with Ocean Springs included, Fed. Aid assured.

**Mo., Monticello**—St. Hwy. Dept. Jefferson City, will constr. 7.94 miles state road northward and southward through La Grange Special Rd. Dist.; grade, constr. draing. structs; 16-ft. wide gravel pavement or gravel surface course on stone base course, etc.; Lewis Co. Fed. Aid. Proj. 39; consturct 8.37 mi. state road from Canton southward and westward; grade, construct draing. structs; 16-ft. wide gravel pavement or gravel surf. on stone base course, etc., Lewis Co., Fed. Aid. Proj. 38. M. J. Hanick, Div. Engr., Howe Bldg., Macon, Mo.

**Mo., St. Louis**—City Council will soon ask bids for 1st of City's program of street and alley reconstruction and resurfacing. Work will cover about 32½ miles and total est. cost is $2,580,000.

**O., Cleveland**—State, County and local funds will

# BUYERS' GUIDE

**Aerial Tramways.**
American Steel & Wire Co.

**Air Lift Pumps.**
Harris Air Pump Co.

**Armor Plates.**
Truscon Steel Co.

**Asphalt.**
Bitoslag Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

**Asphalt Filler.**
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

**Asphalt Floors.**
The Barrett Co.
The Texas Co.
Warren Bros. Co.

**Asphalt Machinery.**
Cummer & Son Co., The F. D.

**Asphalt Plants.**
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

**Asphalt Railroad Plants.**
Cummer & Son Co., The F. D.
Warren Bros. Co.

**Asphalt Tools.**
Littleford Brothers.
Warren Bros. Co.

**Asphalt Tool Wagons.**
Littleford Brothers.

**Auto Fire Apparatus.**
Diamond T Motor Car Co.
Duplex Truck Co.
Garford Co., The.
Kissel Motor Car Co.
International Motor Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

**Back Fillers.**
Austin Machinery Corporation.
Pawling & Harnischfeger.

**Bar Cutters and Benders.**
Koehring Machine Co.

**Bars, Reinforcing.**
Truscon Steel Co.

**Binders, Road.**
The Texas Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
Uvalde Asphalt Paving Co.
Warren Bros. Co.

**Bitulithic Pavements.**
Warren Bros Co.

**Blasting Accessories.**
E. I. du Pont de Nemours & Co., Inc.

**Blasting Powder.**
E. I. du Pont de Nemours & Co., Inc.

**Bodies.**
Lee Trailer and Body Co.
Littleford Brothers.

**Braces, Extension.**
Kalamazoo Fdy. & Machine Co.

**Brick Rattlers.**
Olsen & Co., Tinius.

**Brick-Testing Machinery.**
Tinius Olsen Testing Mach. Co.

**Bridges.**
Lewis-Hall Iron Works.

**Buckets, Dredging, Excavating and Sewer.**
Pawling & Harnischfeger.

**Buckets, Dumping.**
Littleford Brothers.
Pawling & Harnischfeger.

**Cableway Accessories.**
Sauerman Bros.

**Cableway Excavators.**
Sauerman Bros.

**Calculators.**
Kolesch & Co.

**Car Unloaders.**
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

**Castings.**
U. S. Cast Iron Pipe & Fdy. Co.

**Cast Iron Pipe.**
U. S. Cast Iron Pipe & Fdy. Co.

**Catchbasins.**
Dee Co., Wm. E.
Madison Foundry Co.

**Cement Testing.**
Kirschbraun, Lester.

**Cement Testing Machinery.**
Tinius Olsen Testing Mach. Co.

**Central Heating Plants.**
American District Steam Co.

**Chimneys, Concrete.**
Truscon Steel Co.

**Chimneys, Steel.**
Lewis-Hall Iron Works.
Littleford Brothers.

**Chloride of Lime.**
Pennsylvania Salt Mfg. Co.

**Chutes, Concrete.**
Heltzel Steel Form & Iron Co.
Littleford Brothers.

**Concrete Mixers.**
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L., The

**Concrete, Reinforcement.**
American Steel & Wire Co.
Truscon Steel Co.

**Conduits.**
Cannelton Sewer Pipe Co.
Carey Co., Philip, The.
Truscon Steel Co.

**Conduit Rods.**
Stewart, W. H.

**Conduits, Wood, Creosoted.**
Republic Creosoting Co.

**Consulting Engineers.**
Alvord, John W.
American Appraisal Co.
Artingstall, Wm.
Brossman, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Gannett, Seelye & Fleming Co.
Hill & Ferguson.
Howard, J. W.
Hunt & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Luten, Daniel B.
Morse, Wm. F.
Potter, Alexander.
Van Trump, Isaac.
Wells, James P.

**Contractors.**
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

**Contractors' Tools and Machinery.**
Austin Machinery Corporation.
Austin-Western Co., Ltd., The
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L., The

**Contractors' Wagons.**
Austin Machinery Corporation.
Austin-Western Co., Ltd., The

**Conveying Machinery.**
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

**Cranes and Hoists.**
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling & Harnischfeger.

**Creosote.**
The Barrett Co.
Republic Creosoting Co.

**Creosoted Wood Block.**
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

**Crushers, Rock and Ore.**
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

**Culvert Molds.**
Austin-Western Co., Ltd., The

**Culvert Pipe, Vitrified.**
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

**Culverts.**
Newport Culvert Co.
Truscon Steel Co.

**Curb and Gutter Forms.**
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

**Curb Bar.**
Truscon Steel Co.

**Direct Oxidation Process.**
Direct Oxidation Process Corp.

**Disinfectants.**
Integrity Chemical Co.

**Drag-Line Excavators.**
Austin Machinery Corporation.

**Drag Scrapers.**
Austin-Western Road Machinery Co.

**Drain Tile.**
Dee Clay Mfg Co., W. E.

**Drawing Materials.**
Kolesch & Co.

**Dryers.**
Cummer & Son., The F. D.

**Dump Cars.**
Austin-Western Road Machinery Co.

**Dump Wagons.**
Austin-Western Road Machinery Co.

be combined in financing road program in Cuyahoga County. Est. cost of program is $2,500,000 for 85 paving new paving. This will include 40 roads.

**O., Marysville**—Commrs. have granted petitions for impvt. of sects. of 13 roads in Union Co.—total of 60 miles—at est. cost of $150,000.

**Ore., Portland**—U. S. Forest Service will build 500 mi. of road costing $281,000 this year in Oregon; 434 mi. of trail, $64,000 & 4 bridges costing $2600. In addn., there will be $26,000 for maintenance of trails and $36,000 for maint. of roads. F. H. Brundage, Forest Inspector. Total allotment for the 14th forests in state amounts to $415,000, with $66,000 additional from counties.

**N. J., Newark**—Specfs. prepared by Co. Engr. Stickel for road improvements—6 roads and 2 small bridges. Est. total cost $600,000. Specfs, will be submitted to St. Hwy. Comn. for approval. Co. Purchasing Agt. Bergen will advertise for bids as soon as approval is granted.

**N. Y., Oneida**—A 16-ft. conc. hwy. will be built this summer along gorge route 4½ miles so. from Chittenango toward Cihittenango Falls and Cazenovia. Est. cost $166,000.

**N. Y., Troy**—Total appropriation of $144,898 for hwy. constr. in Washington Co. authorized by Bd of Supvrc., at Hudson Falls. $76,000 allotted for hwy. units from Whitehall to Dresden Centre and from Whitehall to Dresden Sta. Total cost of this proj. $25,000. $6858 allotted for strip of hwy. in village of Greenwich. Third proj., involving constr. of hwy. from Hartford town line to Kingsbury town line—5 miles—authorized at expendt. of $62,400. Total cost of this link will be $206,800.

**N. C., Asheville**—Mount Mitchell Development Co. plans expendt. of $100,000 to develop Mt. Mitchell motor road .

**N. C., Hamlet**—$75,000 additional for street paving program voted by Bd. of Aldermen. Bonds will be issued as soon as possible. This brings total paving program up to 50,000 sq. yds.

**Pa., Hastings**—Co. Commrs. notified by St. Hwy. Dept. that plans are being prepared for reconstr. of Sec. 1, Route 21, connecting Patton and Hastings. J. L. Herber, Engr. for 11th Dist. asked Commrs. for approval of use of 3-in. or 4-in brk. for paving rd. and approval has been given. Bids will also be asked for bldg. Sect. 2, Route 62, Spangler & E. Carroll Twp. section.

**S. D., Aberdeen**—Brown County will construct 19 mile hwy. from Hecla to Frederick. G. A. Peppers Aud.

**S. D., Yankton**—Commrs. Yankton Co. decided ot construct roads 9, 18, 19,—17 miles. H. H. Corbin, Co. Hwy. Engr., J. D. McCoun, Aud.

**Tenn., Nashville**—State Hwy. Comn., Nashville, will constr. 6 mi. bitum. macadam rd. from Mascot to Grainger Co. line at cost of $600,000; Knox Co., FAP.; 13.94 mi. chert rd.—Lexington to Madison Co. line, $278,800; Henderson Co., F. A. P.; 20 mi. bitum. mac. rd. from Memphis to Fayette Co. line, at $600,000, Shelby Co. FAP; 5.27 mi. bitum conc.—Nashville city limits to Harding pike, $585,000: Davidson Co. FAP; 9 mi. bitum rd. from Pikeville to Rhea Co. line, $330,000; Bledsoe Co. FAP; 2.23 mi. gravel rd. from Barren Plains to Keysling Rd., $12,000; Robertson Co., FAP; 12 mi. bitum. macadam rd. from Madison Co., to Carroll Co. line ;$360,000, Gibson Co. FAP; 7.90 mi. bitum. macadam rd. Untion City to Terrell, $237,000, Omion Co. FAP; 16.05 mi. bitum. macadam rd.—Waverly to Dickson Co. line, $400,000, Humphreys Co., FAP; 31 mi. bitum. macadam rd.—Washington Co. to Hawkins Co. line, $850,000, Green Co., FAP; 1.76 mi. bitum. macadam rd.—Huntingdon to McKenzie, $382,000, Carroll Co., FAP; 15 miles bitum mac. rd. from Kingston to London Co. line, $450,000, Roane Co. FAP; 37 mi. bitum. mac. rd. from Mont Eagle to Warren Co. line, $1,000,000; Grundy Co. FAP; 10.60 mi. bitum. macadam—Davidson Co. line to Dickson Co. line; $365,000, Cheathem Co. FAP; 5.50 mi. conc. rd. from Sta. 102 to Forks-Duck Cry., $250,000; Hamilton Co., FAP; 22 mi. bitum. macadam rd. from Dandridge to Knox Co. line; $600,000, Jefferson Co. FAP; 3.50 mi. bitum. macad. rd. from Milligan College to Unicoi Co. line, $87,500.

**Tex., Edinburg**—$1,250,000 bonds voted by Hidalgo Co. for constr. of 2 conc. paved highways across county. Geo. P. Brown, Co. Judge, Edinburg; P. S. Devine, Co. Engr., Pharr, Tex.

**Tex., Kerrville**—Chf. Engr., U. S. Bureau Pub. Rds., Washington, D. C., has approved plans to construct 13.9 miles gravel rd. on St. Hwy. No. 27—Kerr Co. line to Ingram; $107,136; 6.7 mi. 16-ft. gravel rd. on State Hwy. 27 bet. Kerrville and Ingram, $48,000; also 11.05 mi., 16-ft. gravel rd. on St. Hwy. 27 betw. Ingram and Mtn. Home, $180,000. Lee Wallace, Co. Judge, Kerrville; W. E. Simpson, Co. Engr. 414 National Bank Bldg., San Antonio, Tex.

**Tex., San Benito**—Specfs. for hard surfaced hwy. thruogh Hidalgo Co., being prepared by Pat Devie, Co. Engr. Bids may be asked on 3 types of paving. Constr. will be financed by proceeds from a $1,250,000 bond issue recently voted.

**Utah, Salt L. City**—State plans to expend $5,000,000 on road work this year. There are already under contract 8 projects. Of these Fed Govt. is bearing $1,098,004.22 of the cost. On projects where contracts are not yet let, fed. aid program, approver Mch. 20, contemplates apportioning $2,253,659 of fed. aid. Both this latter figure and money allotted to projects under contract, include only fed. aid, and not portion raised by county or state. New projects contemplated in program, in addition to contracst already let, are as follows: Magna to Tooele, $160,685; Morgan to Peterson, $45,000; Brigham to Corinne, $116,550; Woodruff to Wyoming, $33,000; Pigeon Hollow to Juab, $70,000; Richfield North, $70,000; Castlegate to Emery, $60,000; Summit Co., $30,000 and Heber to Summit, $50,000. In hard surf. constr., rough estimates place mileage on which construction is to begin this yr. at 51 mi. Tentative ests., place mileage of dirt roads, on which constr. is to be done this yr., at 132 miles.

**Va., Richmond**—State Hwy. Comn., sets aside $300,000 for Lee Hall-Toano Rd., known as Route 9. Allocations of new work for year, amounting to $5,105,000 announced. In addn., $210,000 in work under allocations made in 1921, will be carried on, making total authorized for year $5,315,000.

**Wn., Walla Walla**—Town contemplates expending approx. $90,557 if entire paving program is approved. Work of compiling ests. on various projects has been completed. Largest district is that of Chestnut St. which will cost approx. $50,000. Abt. 1 mi. paving, grading and curbing will be needed on this street.

**W. Va., Fairmont**—$391,000 bonds voted at recent election for paving in First and Second Wards in City.

**Wis., Oshkosh**—City and Winnebago County will expend approx. $2,000,000 for public impvts. this year. City will expend approx. $100,000 for paving 9 streets (mostly with Asphalt); 2 streets with surf. of oil macadam and still another street with Tarvia X penetration; also new sewers in 5 streets and in addition a large amount will be spent to replace or repair old sewers, etc.

## SEWERAGE AND SEWAGE TREATMENT

**Cal., Burbank**—Trustees have declared their intentions to call elec. for June 20 to vote on $100,000 bond issue for purpose of constructing san. system, including pipe line, sewage treat. plant, conduits, etc. in Municipal Impvt. Dist. No. 1.. F. C. Miller, City Engr.

**Cal., Pasadena**—$412,000 bonds voted here for constr. of sewage treatment and disposal system.

**Cal., San Luis Obispo**—Council contemplates extending city's sewage system at cost of $17,000, and to construct new septic tank for sewer farm to cost approx. $15,000. Culvts. costing $6000 are also named as necessary impvt.

**Cal., Santa Ana**—Proposal to install addn. fall sewer system to be constructed jointly by Santa Ana and Anaheim, voted on favorably. Anaheim's proportion, $240,000 and Santa Ana's, $321,000. Comb. cost of treating plant and outfall line to ocean will be $252,000. For constructing sewer mains Anaheim voted $160,000 and Santa Ana, $149,000.

**Ill., Chicago**—Plans being made for sewers in various streets here. Est. cost $230,000. C. D. Hill, City Hall Engr.

**Ill., Niles**—City preparing plans for bldg. sewers and water works. Est. cost $40,000. Consoer Engineering Co., 140 S. Dearborn St., Chicago, Ill.

**Ind., Hammond**—Bd. Pub. Wks. contemplates expending $500,000 for main sewer on South Side and $900,000 for main sewer on North Side. Engrs. A. J. Swanson & W. F. Briggs, City Hall.

**Ia., Boone**—Plans and ests. approved for sewage

# BUYERS' GUIDE

**Dust Laying Compound.**
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

**Dynamite.**
E. I. du Pont de Nemours & Co., Inc.

**Edge Protector.**
Truscon Steel Co.

**Electrical Wires & Cables.**
American Steel & Wire Co.

**Elevating Graders.**
Austin-Western Road Machinery Co.

**Elevators.**
C. H. & E. Mfg. Co.

**Engineering Instruments.**
Kolesch & Co.
Lufkin Rule Co., The

**Engines.**
C. H. & E. Mfg. Co.

**Excavating Machinery.**
F. C. Austin Machinery Co.
Pawling & Harnischfeger.
Sauerman Bros.
Smith Co., T. L., The

**Expansion Joint Compound.**
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Truscon Steel Co.

**Explosives.**
E. I. du Pont de Nemours & Co.

**Fence, Iron.**
Cincinnati Iron Fence Co.

**Fillers (Paving Joint).**
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.

**Fire Brick.**
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

**Flue Liners.**
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

**Forms, Sidewalks, Curb & Gutter.**
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

**Forms, Road.**
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

**Forms (Sewers & Conduits).**
Heltzel Steel Form & Iron Co.

**Forms (Wall Bldg., Construction, Etc.).**
Heltzel Steel Form & Iron Co.

**Gas Pipe.**
U. S. Cast Iron Pipe & Fdy. Co.

**Graders.**
Austin-Western Road Machin-
Good Roads Machinery Co., Inc.
ery Co.

**Granite Block.**
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

**Gravel Screener and Loader.**
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

**Heaters (Rock and Sand).**
Littleford Bros.

**Heating Plants, Central.**
American District Steam Co.

**Heating Wagons (Oil and Tar).**
Good Roads Machinery Co., Inc.
Littleford Bros.

**Hoists (Concrete, Gasoline and Hand).**
Pawling & Harnischfeger.

**Hoists, Electric .**
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.

**Hoists, Steam.**
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

**Hot Mixers.**
F. C. Austin Machinery Co.

**Hydrants.**
The Flower Company.

**Incinerators.**
William F. Morse.

**Inlets (Sewer).**
Dee Co., Wm. E.
Madison Foundry Co.

**Insulating Material.**
The Barrett Co.
Pioneer Asphalt Co.

**Joint Fillers (Paving).**
The Barrett Co.
Carey Co., Philip, The.
The Texas Company.

**Kettles (Portable).**
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

**Loaders.**
Brown Portable Conveying Machinery Co.

**Manhole Covers.**
Madison Foundry Co.
Dee Co., Wm. E.

**Mastic.**
Pioneer Asphalt Co.

**Meter Boxes.**
McNutt Meter Box Co.

**Mixers, Asphalt.**
Austin Machinery Corporation.
Cummer & Sons Co., The F. D.

**Mixers, Concrete.**
Austin Machinery Corporation.
Koehring Machine Co.
T. L. Smith Co.

**Mixers—Mortar.**
C. H. & E. Mfg. Co.

**Molds (Pipe & Culvert).**
Heltzel Steel Form & Iron Co.

**Motor Fire Apparatus.**
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

**Motor Trucks.**
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

**Motor Truck Flushers, Sprinklers. and Oilers.**
Acme Motor Truck Co.
Austin Machinery Corporation.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

**Muhicipal Castings.**
Dee Co., Wm. E.
Madison Foundry.

**Packing.**
Pioneer Asphalt Co.

**Paints (Asphalt).**
Barrett Co., The
Pioneer Asphalt Co.

**Paving Blocks (Creosoted).**
The Barrett Co.
Republic Creosoting Co.

**Paving Brick.**
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

**Paving Contractors.**
Warren Bros. Co.

**Paving Joint Compound.**
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

**Paving Joint Filler.**
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

**Paving Machines.**
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

**Paving Plants (Asphalt).**
Austin Machinery Corporation.
Cummer & Son., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Smith Co., T. L., The
Warren Bros. Co.

**Pipe Cutters.**
W. W. Stickler & Bros.

**Pipe Dip and Coatings.**
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

**Pipe Manufacturers.**
U. S. Cast Iron Pipe & Fdy. Co.

**Pitch Filler.**
The Barrett Co.
Warren Bros. Co.

**Plows (Rooter and Wing).**
Austin-Western Road Mach. Co.

**Portable Paving Plants.**
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

**Portable Stone Bins.**
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

**Powder (Blasting).**
E. I. du Pont de Nemours & Co., Inc.

disp. plant for which bond elec. will soon be called. Est. cost $71,000. Burns & McDonnell, Cons. Engrs., Kans. City, Mo.

**Kans., Wilson**—W. B. Rollins, City Engr., has submitted report on prelim. survey of City for san. sewer and draing. purposes. Est. cost of complete sewer system $47,000.

**La., Baton Rouge**—City Comm. plans to construct 109,250 ft., (about 20 miles) sewer extension. $122,038. Jno. J. Mundiger, City Engr.

**La., Haynesville**—$85,000 bonds voted for disposal plant and sewer construction.

**Mich., Royal Oak**—Voters have approved propositions to bond City for $300,000 for construction of sanitary sewerage system and disposal plant.

**Mo., St. Joseph**—Resolution designating manner in which $795,000 bond issue for main sewers, is to be used, passed at special meeting of Council.

**N. J., Haddon Heights**—Will soon ask bids for 4 miles conc. and brk. sewers in various streets. Est. cost $30,000. B. Franklin Co., Crozier Bldg., Phila., Engrs.

**N. Y., East Aurora**—$77,000 bonds voted for additions to sewerage system. F. H. Ball, Pres.

**N. Y., Manchester**—Mayor Geo. E. Trudel anxious to start work immediately on proposed million dollar storm sewer project.

**N. Y., Schenectady**—$100,000 bonds voted for san. sewer in Erie Blvd. and extending storm sewer sys. in other streets. G. Howard, City Engr.

**N. C., Elizabeth City**—City having survey made by J. B. McCrary, Engr. Co., Atlanta, Ga., for impvts. to sewer system.

**N. C., Leaksville**—City will construct sewer cost at cost of about $110,000. J. W. Webb and E. W. Cole., Civ. & Cons. Engrs.

**O., Cleveland**—Co. Commrs. promise relief in sewer situation in Parma Twp., comprising 132 streets. Residents in 32 allotments desire sewers and other sanitary arrangements.

**Ore., Pendleton**—Bond Ord., for issuance of $85,000 of money recently voted by citizens for septic tank sewer system, authorized by Council. Est. submitted by Barr & Cunningham, Engrs., call for total expendt. of $69,919. Real est. on which proj. will be constructed will cost $20,000.

**Pa., Harrisburg**—Permits for more than a score of water and drainage impvts. issued by St. Dept. of Health. They include sewerage plants for Johnstown, Lock Haven, Monessen, Monongahela, New Castle, Freedam, Midland, Muncy and Corry.

**Pa., Phila.**—City will soon ask bids for 9½ miles sewers at cost of $180,000. J. A. Vogelson, City Hall, Engr.

**Pa., Pittsburgh**—Ord. given two readings, and expected to be passed at next meeting by Council, for issuance of $143,000 bonds for sewers and impvts. in McKeesport streets.

**S. C., Ware Shoals**—Ware Shoals Mfg. Co. will install sewer system for 100 homes, to be erected.

**Va., Portsmouth**—Having plans prepared for sewers in Park View, $32.885, Randolph St., trunk sewer, $148,000, Glasgow St. trunk sewer, $150,000. $360,000 bonds will be issued for work. J. F. Weaver, Jr., 404 Court St., Engr.

**Wis., Birchwood**—$40,000 bonds voted for sewer system.

## WATER SUPPLY AND PURIFICATION

**Ark., Conway**—City will issue $150,000 bonds for impvt. and enlargement of water system. E. V. Leverett, Supt.

**Ark., Piggott**—Chamber of Comn. has unanimously endorsed plans of Comn., for water works, sewerage and light system for Piggott. Est. cost, $125,000. There will be about 9½ mi. water main, equal amt. of sewerage pipe and about 10 mi. light wire. Bonds will be issued immediately.

**Cal., Alameda**—Nine municipalities in Alameda County have agreed to organize into municipal utility district for purpose of acquiring water supply; possibly other utilities such as light, power and transportation.

**Cal., Pasadena**—$175,000 bond issue for water storage and distribution sys., carried at special election.

**Ont., Essex**—Plans being prepared for reservoir with 500,000 imp. gal. capy., elec. operated domestic pump 150 gal. per min. reserve pump 750 gal. per min. to be operated by high speed gasoline eng.; also new pumphouse. $40,000. Prices desired on all materials. James, Proctor & Redfern, 36 Toronto St., Toronto, Engrs.

**Ont., Port Credit**—Contemplate 4 miles cast iron mains, 1,000 ft. steel intake, pumphouse, centrif. pumps, water tank, $120,000. Gore, Nasmith & Storrie, Confederation Life Bldg., Toronto, Engrs.

**Ont., Smith's Falls**—Provincial Health Dept. insists on installation of filtr. plant, in connection with water works system.

**Ida., Idaho Falls**—Plans for new pumping station, filtr. plant and other water works impvts., presented and approved. Bond election for $250,000 will be called last week in May. Burns & McDonnell, Cons. Engrs., Kans. City, Mo.

**Ill., Jacksonville**—Making plans for 4-6 in. mains. Est. cost $30,000. Caldwell Eng. Co., City Hall, Engrs.

**Ill., Sheffield**—Town considering constr. of water supply system. Engineer not selected. B. W. Borden, Pres.

**Ia., Haynesville**—$45,000 2bonds voted for water main extension.

**Me., So. Portland (Portland P. O.)**—Portland Water Dist. having prelim. plans made for extending water system here. Est. cost $100,000. L. Metcalf, 14 Beacon St., Boston, Engr.

**Mo., Kansas City**—$11,000 bonds voted here for water works impvts.

**Mo., St. Louis**—City considering installing one 20,000-gal. crank and fly-wheel type triple expansion pumping engine with vacuum pump, boiler, feed and air compressor, etc., $75,000.

**Mo., Trenton**—Plans and ests. for water works impvts., including filtr. and other impvts. presented and approved. Bond elec. $150,000 soon. Burns & McDonnell, Cons. Engrs., Interstate Bldg., Kans. City, Mo.

**N. Y., Gouverneur**—Plans being made for new water supply system; $50,000 to $75,000. $3,000 voted to drill test wells.

**N. Y., Locust Valley**—Plans 18 miles mains with pumping station, Tanks, etc. $330,000. S. B. Bowne, Mineola, Engr.

**N. Y., Schenectady**—Bd. Pub. Wks., making plans to replace 36-in. main from here to pumping station at Rotterdam, at $150,000. G. Howard, City Engr.

**N. Y., Troy**—Ord. authorizing Comptroller to pay for cost of extending water mains in city adopted unanimously. Cost $70,000.

**N. C., Kinston**—City will develop additional water supply; install 2½ miles 10-in. cast iron pipe, drill 2 or 3 wells, install pump, etc. Wm. C. Olsen, Cons. Engr.

**N. C., Leaksville**—City will construct water system at cost of about $125,000. J. W. Webb, E. W. Cole, Civil & Constr. Engrs., Salisbury, N. C.

**N. C., Morgantown**—Town will install gravity system of water works. About 12 mi. pipe line and dam; 10,000,000 gals. daily capy. Est. cost $200,000. O. B. Lackey, Mgr.

**Okla., Beggs**—$50,000 water works bonds voted.

**Okla., Henryetta**—$45,000 bonds voted here for extension of water works system.

**Tenn., Memphis**—City will construct water works; erect pumping sta. and filter bldg., capy. 20,000 gals. daily; conc. covered reservoir, 11,000,000 gals. daily, cast iron pipe line, $300,000; install boilers, crank and fly-wheel pumping engine, air compressors, turbine, centrif. pumps, cooling towers, ponds and spray nozzles, traveling cranes, coal-handling equip. Amt. to be extended $2,000,000. Constr. bids opened probably in September; machinery bids in June. Fuller & McClintock, Engrs., 421 Produce Exch. Bldg., Kans. City, Mo.

**Tex., Kerrville**—Phelps & Dewees, Archts., Gunter Bldg., San Antonio, Tex., preparing plans for sewer, sewage disposal plant and water softening plant for American Legion Sanatorium. S. B. Cowell. Chrmn. Bldg. Comn. Will invite competitive bids.

**Tex., Ft. Stockton**—Prelim. surveys and estimates made for complete water works. $75,000. Berrell-Bartlett, Calcasieu Bldg., San Antonio, Tex., Engrs.

**Tex., Waxahachie**—$37,000 water and sewer bonds sold and new deep well will be drilled. Water Comm. will select location for well. Hole will be sunk to Trinity sand.

**W. Va., Wheeling**—$2,000,000 bonds voted here for filtration system.

# BUYERS' GUIDE

**Pumps.**
C. H. & E. Mfg. Co.
De Laval Steam Turbine Co.
Harris Air Pump Company.
Midwest Engine Co.
Smith Co., T. L., The

**Reinforcing For Pavements.**
American Steel and Wire Co.
Truscon Steel Co.

**Road Building Material.**
Kentucky Rock Asphalt Co.
The Texas Co.

**Road Binder.**
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

**Road Forms.**
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

**Road Graders.**
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

**Road Machinery.**
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Midwest Engine Co.
Warren Bros. Co.

**Road Planer.**
Austin-Western Road Machinery Co., The

**Road Oil and Preservatives.**
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

**Road Rollers.**
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Good Roads Machinery Co., Inc.

**Rock Crushers.**
Austin-Western Road Machinery Co.
The Good Roads Machinery Co., Inc.

**Roofing Material.**
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros. Co.

**Sand Dryers.**
Cummer & Son Co., The F. D.
Littleford Brothers.

**Saw Rigs.**
C. H. & E. Mfg. Co.

**Scarifiers.**
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

**Scrapers, Drag Line.**
Pawling & Harnischfeger.
Sauerman Bros.

**Scrapers, Graders, Plows, Etc.**
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

**Scrapers, Power.**
Sauerman Bros.

**Sewage Treatment.**
Direct Oxidation Process Corp.

**Sewer Braces.**
Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

**Sewer Cleaning Machinery.**
Stewart, W. H.

**Sewer Forms.**
Heltzel Steel Form & Iron Co.

**Sewer Pipe.**
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

**Sewer Rods.**
Stewart, W. H.

**Slide Rules.**
Kolesch & Co.

**Sluice Gates.**
Coldwell-Wilcox Co.

**Snow Removal Machinery.**
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.
Phoenix Mfg. Co.

**Soaps—Liquid.**
Integrity Chemical Co.

**Special Castings.**
The Flower Company.
U. S. Cast Iron Pipe & Fdy. Co.

**Sprinklers.**
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

**Steel Joists, Studs and Sash.**
Truscon Steel Co.

**Steel Tapes.**
Kolesch & Co.
Lufkin Rule Co., The

**Stone Crushers.**
Austin-Western Road Machinery Co., The

**Stone Elevators.**
Austin-Western Road Machinery Co., The

**Stone Spreaders.**
Austin-Western Road Machinery Co., The
Burch Plow Works Co.

**Stone Screens.**
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.
Littleford Bros.

**Street Cleaning Machinery (Horse Drawn).**
Austin-Western Road Machinery Co., The

**Street Flushers (Horse Drawn).**
Austin-Western Road Machinery Co., The

**Street Paving Material.**
The Texas Co.

**Street Sprinklers (Horse Drawn).**
Austin-Western Road Machinery Co., The

**Structural Steel.**
Lewis-Hall Iron Works.

**Surveyors' Instruments.**
Kolesch & Co.
Lufkin Rule Co., The

**Sweepers.**
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

**Tamping Machines.**
Pawling & Harnischfeger.

**Tanks, Water Supply.**
Littleford Brothers.

**Tar and Pitch**
The Barrett Co.

**Tar Heaters.**
Littleford Brothers.

**Tarvia.**
The Barrett Co.

**Testing Chemists.**
Dow & Smith.
Walter H. Flood.
Howard, J. W.
Kirschbraun, Lester.
Nutting Co., H. C.
Van Trump, Isaac.

**Traction Engines.**
Austin-Western Road Machinery Co., The

**Traction Engines (Oil or Kerosene).**
Austin-Western Road Mach. Co.

**Tractors.**
Austin Machinery Corporation.
Holt Mfg. Co., Inc.

**Traffic Signals.**
Electrical & Specialty Supply Co.
Little Giant Co.

**Trailers.**
Lee Trailer and Body Co.

**Trench Braces.**
Kalamazoo Fdry. & Mach. Co.

**Trench Machinery.**
Austin Machinery Corporation.
Kalamazoo Fdry. & Machine Co.
Pawling & Harnischfeger.

**Turbines, Steam.**
De Laval Steam Turbine Co.

**Valves.**
Coldwell-Wilcox Co.
The Flower Company.

**Wall Coping.**
Cannelton Sewer Pipe Co.

**Warrenite.**
Warren Bros. Co.

**Water Main Cleaning.**
National Water Main Cleaning Co.

**Water Pipe.**
U. S. Cast Iron Pipe & Foundry Co.

**Waterproofing.**
Barber Asphalt Co.
Barrett Co., The
Pioneer Asphalt Co.
The Texas Co.
Truscon Steel Co.

**Water Purification.**
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

**Water Softener.**
The Refinite Co.

**Water Works Supplies and Equipment.**
Coldwell-Wilcox Co.
The Flower Company.
Pennsylvania Salt Mfg. Co.

**Wheeled Scrapers.**
Austin-Western Road Machinery Co.

**Wire Rope.**
American Steel & Wire Co.

**Windows (Steel).**
Truscon Steel Co.

**Wire-Cut Lug Brick.**
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

**Wood Block (Creosoted).**
Barrett Co., The
Republic Creosoting Co.

**Wood Preservatives.**
Barrett Co., The
Republic Creosoting Co.

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# Warrenite-Bitulithic Pavement

*There* is the proof of all pavements. What our pavement has done *near* you it can do *for* you.

Made right and laid right, it conforms to the most rigid standards of quality, backed by the highest type of service. Scientifically correct in its composition, laid under expert supervision according to the best engineering practice, **Warrenite-Bitulithic Pavement** leaves nothing to chance and it makes good everywhere.

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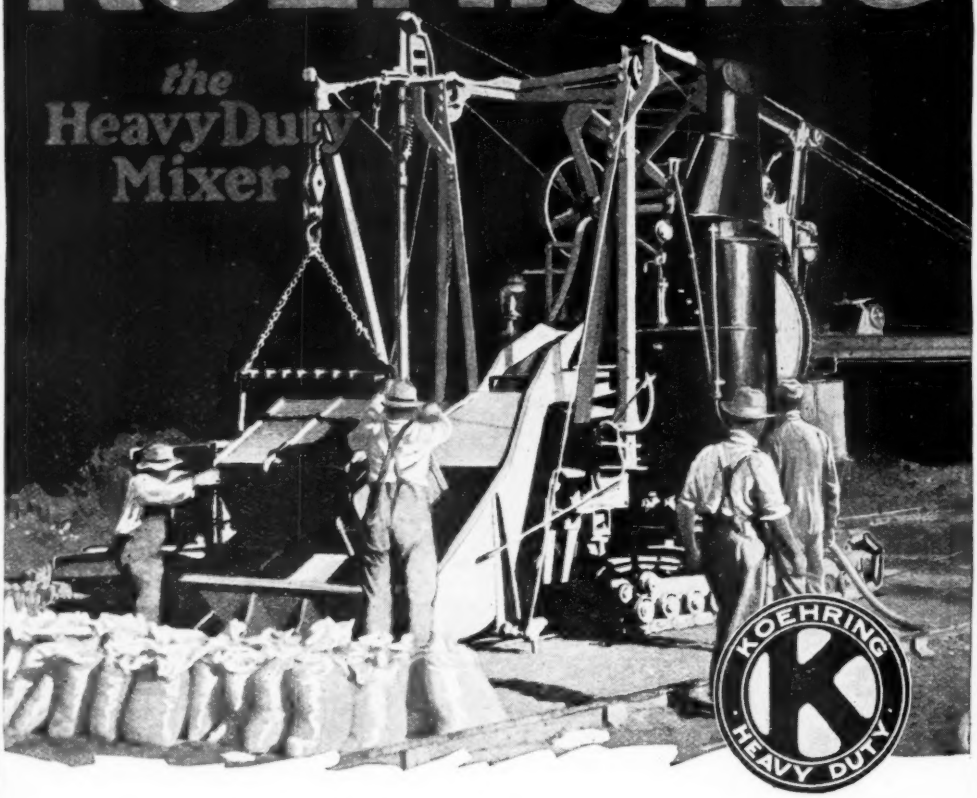


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